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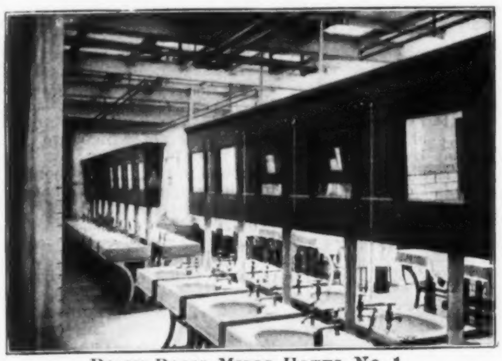
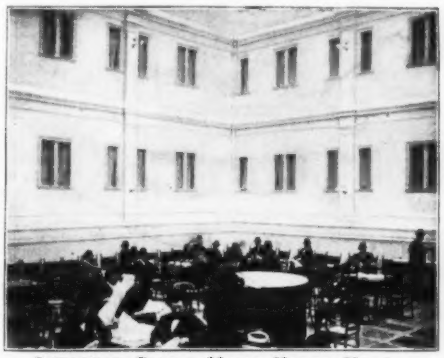


BASIN ROOM, MILLS HOTEL No. 1.



INTERIOR COURT, MILLS HOTEL No. 1.

CORNER OF RESTAURANT, MILLS HOTEL No. 1.

BAGGAGE ROOM, MILLS HOTEL No. 1.

MILLS HOTEL No. 2.

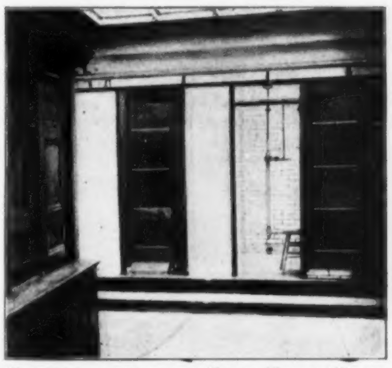
WRITING ROOM, MILLS HOTEL No. 1.

KITCHEN, MILLS HOTEL No. 1.

INTERIOR COURT, MILLS HOTEL No. 2.

CORNER BEDROOM, MILLS HOTEL No. 1.

MILLS HOTEL No. 1.



CORNER OF SHOWER-BATH ROOM, MILLS HOTEL No. 1.

"SNUGGERY," MILLS HOTEL No. 1.

GUESTS' LAUNDRY, MILLS HOTEL No. 1.

MILLS HOTELS Nos. 1 AND 2.—EXTERIOR AND INTERIOR VIEWS OF MODERN WORKINGMEN'S HOTELS IN NEW YORK.

THE SANITARY EQUIPMENT AND POWER PLANT OF A MODERN LODGING HOUSE.

Specially prepared for the Scientific American Supplement.

Apart from any question of philanthropy, wise or otherwise, no one has ever made a more praiseworthy effort toward improving the sanitary environment of men who seek low-priced hotel accommodations than has the New York millionaire banker, D. O. Mills, in his establishment of two palatial workingmen's hotels, one on the west side and one on the east side of New York city.

The methods adopted, to say nothing of the practical results attained, are worthy of careful consideration. Not only are their inmates surrounded by accommodations unsurpassed in sanitary excellence by those provided in more pretentious metropolitan hotels, but mental as well as physical comforts are supplied at a tithe of the expense for which a man could secure them elsewhere. Nevertheless, the hotels have proved to be successful financially, which to many is more important than success in solving problems in sanitation for the benefit of humanity and the healthful advancement of mankind. What was primarily undertaken in an effort to solve the question of better housing for the respectable class of small-salaried workingmen, in the case of Mills Hotel No. 1, which was the first of the two hotels to be built, turned out to be a profitable business speculation, for approximately the hotel has earned a net profit of about 4½ per cent. yearly on an original investment of $1,000,000, which is about the amount the hotel is said to have cost.

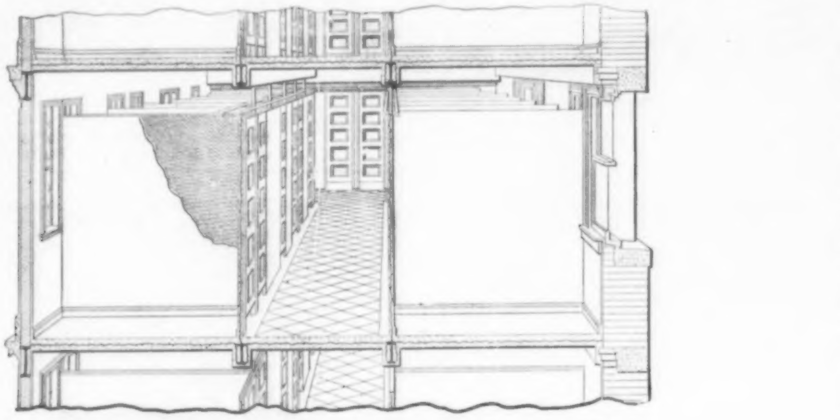
Mills Hotel No. 1, the sanitary equipment of which is to be specifically described, is situated on Bleecker Street, between Thompson and Sullivan Streets, one block from the Sixth Avenue elevated railroad, in what was once the fashionable quarter of old Gotham. As indicated by the accompanying perspective view, the hotel has a massive yet cheerful aspect, its architectural character, as well as the engineering features of the building, having been evolved by Mr. Ernest Flagg, the well-known New York architect and engineer.

It is in two sections, known in the hotel parlance as "East" and "West," and joined by a broad hall in the center. The sole public entrance is on Bleecker Street, between the two wings. On either side of the doors are the registry offices, where the guests pay in advance for their rooms, get their keys, and pass up the handsome marble staircase into the marble foyer, from which access is had to every part of the building. The restaurant in the basement is reached by a separate staircase leading directly from the street entrance. Here in the winter time a maximum of 3,000 meals are served daily. On what is practically the first floor, though there are different elevations, are the offices, reading rooms, lavatories, and baths. The nine floors above contain the cubicles or dormitories.

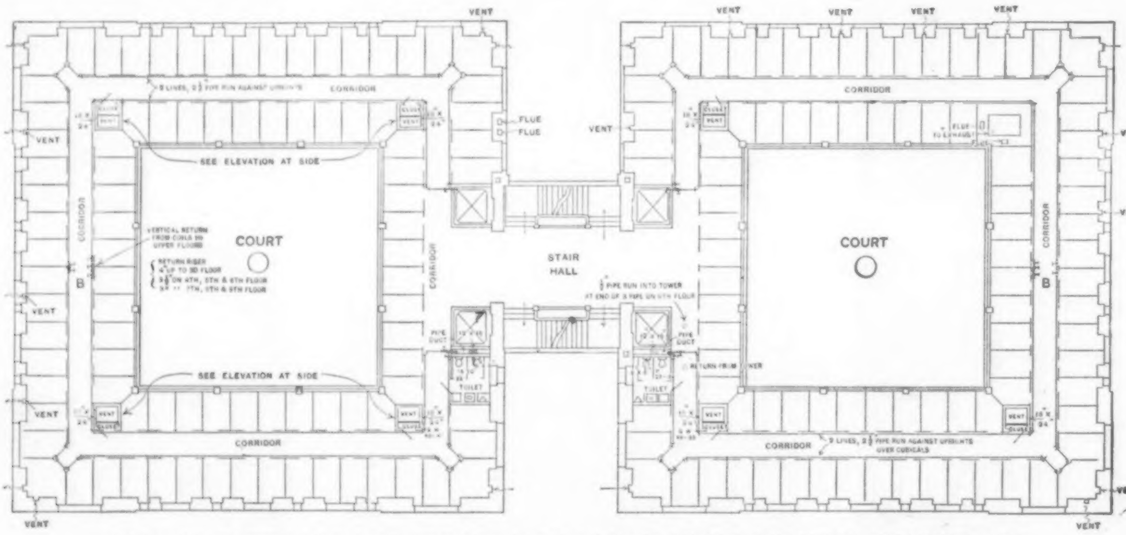
On each side of these bedroom floors corridors run along the four sides of the building, affording access to the 1,554 rooms, something over one-half of which open upon the street, and the remainder upon square interior courts, one of which is partly shown by the view on the front page. The uniform size of the rooms is 5 × 8 feet, but seventy of them are corner rooms about twice as large as the others. The great strength of the establishment is in its vast capacity, which was secured not only by providing large area, but also by economy of space. The floors and room partitions are built on the "expanded metal system," as indicated by one of the engravings presented herewith, insuring strength, lightness, safety from fire and disease germs, with the utmost economy of space. The expanded metal is made from sheet iron, having diamond-shaped meshes, with the flat strands at right angles with the plane of the sheet. This disposition of the metal gives it a very great bearing surface, so that when embedded in concrete or mortar the strength of the combination is greatly enhanced, making possible the construction of light concrete floors of great sustaining power and relatively thin plaster partitions equal in stability to brick walls. The dormitory floors are reached by three elevators, two of which are operated by hydraulic power, the third being run by electricity supplied by dynamos in the engine room, a view of one corner of which is herewith presented. The engine room equipment consists of Ideal engines direct-connected to General Electric dynamos.

Two glass-roofed courts are provided—one in each wing—in which the guests may rest after their day's labor, enjoying some favorite game, an interesting novel, or a quiet smoke, ventilation of the court being such that the latter is permitted without fouling the atmosphere. The reading room adjoins the courts, running along the Bleecker Street front. The writing room, primarily intended for the purpose its name indicates, is used also as a sitting and smoking room.

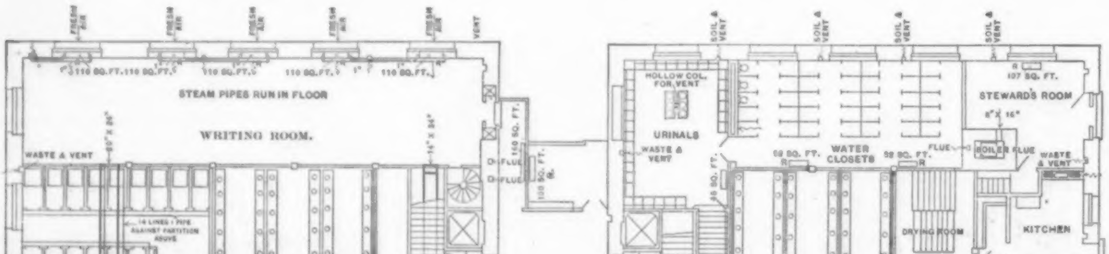
The sleeping rooms, though small in size, are still amply large for the purpose, each containing a bed and chair and shelves for books and papers. They will also hold a steamer trunk, though a trunk room and 1,000 lockers are provided in the basement (see illustration). Between the partition walls and the ceilings there is a space of 18 inches which is closed in by means of wire grilles in order to avoid a sense of insecurity from open-top walls. The seventy corner rooms spoken of are not only larger than the rest, but the walls run up solid to the ceilings. Provision is made so that any who wish to wash their own clothes have every accommodation, including a quick-dryer. These



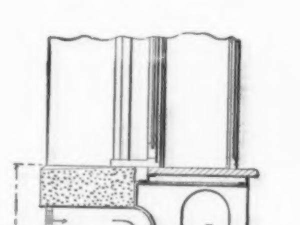
SECTIONAL VIEW THROUGH CUBICLES OR DORMITORIES, MILLS HOTEL No. 1.



TYPICAL FLOOR PLAN OF FLOORS ABOVE FIRST STORY, SHOWING HEATING AND VENTILATING SYSTEM.



GROUND FLOOR PLAN, MILLS HOTEL No. 1, SHOWING HEATING AND VENTILATING SYSTEM.



ARRANGEMENT OF DIRECT-INDIRECT RADIATION.

appliances are freely used, and thus a certain class of the men receive for their twenty cents one more item not furnished by other hotels. To accomplish the sterilization or disinfection of the bedrooms, should occasion require it, small projections or door jambs have been provided in the corridors on the cubicle floors, so that the bedrooms may be shut off in several air-tight sections.

There are water closets on every floor, though the main accommodations in this line are upon the street floor, as are also all the baths and wash rooms (see ground floor plan). Altogether there are about 110 water closets in the building.

No provision is made for ablutions upon any of the bedroom floors, but on the ground floor, as indicated by the plan view, there are located about 200 wash basins, the arrangement of which is shown by the view presented on the front page, which represents about half the equipment of one of the basin rooms, which are located on either side of the main hall. In addition to these hand basins there are also provided thirty Gegenstrom shower baths on the ground floor, one of these baths being illustrated on the front page. The use of these baths, toweling, etc., is perfectly free.

Two National water tube boilers of 300 horse power each supply the steam used for heating and operating engines and machinery, the water of condensation from the heating system and from all high pressure sources, such as hot water heater, steam separator, laundry fixtures, kitchen fixtures, serving room and restaurant serving table fixtures, shower baths, etc., being returned to the boilers by duplex steam pumps. Duplex sewer and house pumps (the latter also being used as a fire pump) complete the pumping outfit.

For the domestic hot water supply there is provided a cylindrical hot water heater of 500 gallons capacity, the heating coil within the heater containing 300 square feet of heating surface in the shape of annealed seamless brass pipe. This heater is connected to the high pressure return, also with the blow-off tanks, and is provided with safety valve, while to prevent loss of heat by radiation it is covered with a 1½-inch coating of asbestos cement. There is also a second tank used for this purpose, of about two-thirds the capacity of the one above mentioned.

The boiler flue, which is 36 inches square, is carried up in a chimney, which also receives the flue from the baker's oven in the bakery in the basement, besides serving as the ventilating flue for the cubicles at one corner of the building. This chimney is 150 feet in height, with a wall 24 inches thick at the bottom, tapering to 1 foot at the top.

The hotel is heated by a direct and direct-indirect system, by means of coils, radiators, and box-base radiators, nothing but exhaust steam, at a pressure of five pounds per square inch, being used in most extreme weather.

For heating the restaurant in the basement an underground coil extending around the outside walls in a brick duct under the basement floor is provided.

The heated air is conveyed from the underground duct to the room through vertical flues in the outside walls.

In the fresh-air inlet for this restaurant heating system there is located a 24-inch motor-driven fan which in summer is used to circulate fresh air in the restaurant, a view of one corner of which, showing location of registers, is presented in connection with this article.

For the heating of the main stair hall, a coil of 1,450 square feet is located under the stairs at the center of the building on the first floor.

Direct radiators are used in the stores, water closets, urinals, manager's apartments, offices, locker rooms, etc.

For heating the reading room and smoking room on the first floor, likewise the restaurant on the ground floor, direct-indirect or box-base radiators are used. They are provided with an opening for fresh air in the back panel and closed down to the floor all the way around, and so arranged that the base can be removed for cleaning. The radiators are supplied with fresh air by means of openings through walls under the windows, as indicated by the diagram herewith.

The registers are set in openings flush with the outside face of the walls. A galvanized iron deflector is placed between the fresh-air inlet and the base of all box-base radiators and is so arranged and made air tight that the entire volume of cold air must pass into the base of the radiator before entering the rooms. The under side of the window sill is also lined with galvanized iron.

The heating of what are termed the cubicle or dormitory floors is accomplished by lines of 2½-inch pipe run around the corridors against uprights over the "cubicle" or guests' rooms. Cubicle partitions stop about 1½ feet below the main ceiling, thus leaving uprights exposed for that distance. The pipes are supported by means of hangers having cast-iron spools, upon which the pipes rest.

The free guests' laundry and the hotel laundry are provided with dry rooms occupying a space about seven feet square, each receiving steam from the same high-pressure main, condensation from both returning through the same high-pressure return to the pump governor located in the tank pit in the engine room. The hotel laundry is equipped with the most modern machinery, part of which is illustrated herewith. The equipment consists of a mammoth mangle, through which the clothes are passed after being washed and wrung out, the mangle serving to thoroughly dry and iron them; two washing machines, one extractor, and one sterilizer, besides the dry room. The capacity of this laundry plant is such that it takes care of the work of Mills Hotel No. 2. It takes care of all restaurant and other linen, besides the bedding, which is changed daily in rooms occupied by "transients," bedding of regular boarders being washed when necessary.

The contractor who installed this system was required to guarantee to warm all bath, basin, water closet and store rooms to 70° in zero weather, likewise the cubicle floors heated by coils to 70° in zero weather, as well as all other parts of the building, all to be done with a pressure of steam of not over five pounds per square inch. He was also required to guarantee that there would be a perfect and noiseless circulation through the entire system with not over two pounds pressure, also that it would be free from all water hammer.

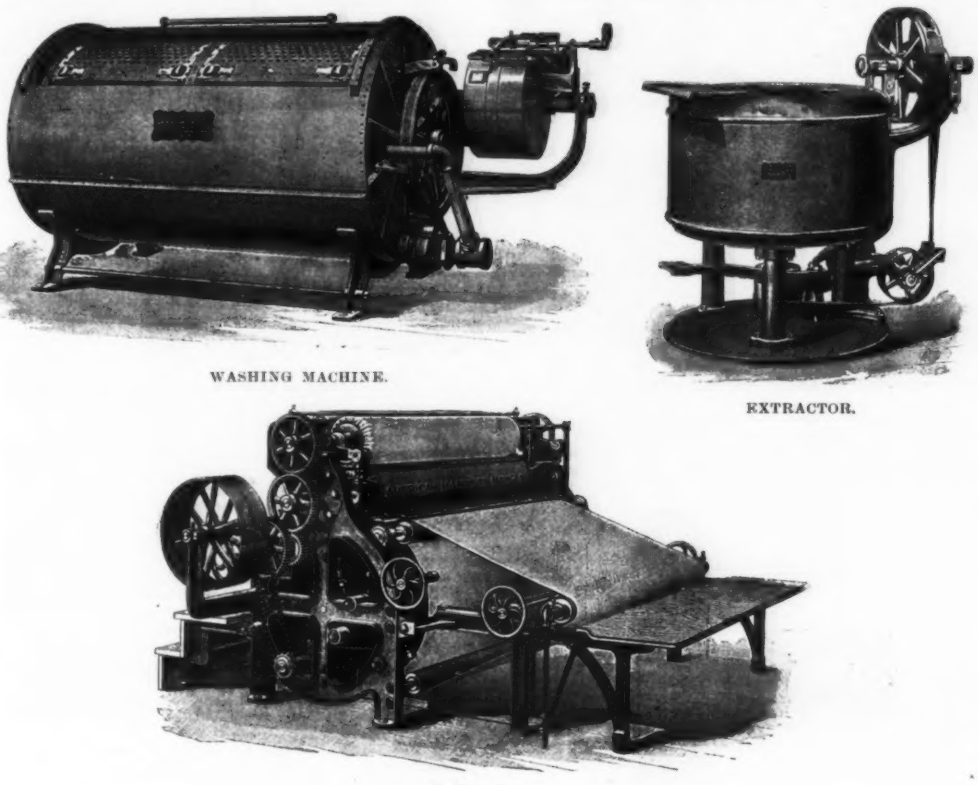
VENTILATING SYSTEM.

The buildings are ventilated by means of an exhaust system, the plant being divided as follows:

First.—That for ventilating the upper part of the building, consisting of seven vertical shafts located on diagonals of building about 25 feet from the corners. See opposite page. Three of these, those at the rear, extend from the first floor to and above the roof, and the remaining four, those at the front, extend from the second floor to and above the roof. This system is used for ventilating the "cubicle" or guests' rooms and courts. In the lofts the flues are provided with sheet-iron doors two feet four inches by four feet.

Second.—That for ventilating the ground and part of the first floor, consisting of two horizontal ducts, run along the ceilings of the stores and emptying into discharge chambers located on the mezzanine between the ground and the first floors at the rear of the elevators.

The two ducts comprising this system ventilate the restaurant, baths, basin, and clothes washing rooms, together with the manager's chamber on the mezzanine floor and the reading and smoking rooms on the first floor. The registers in the latter rooms are located under seats on vertical partition set back about one-half the width of the seat, the partition being a part

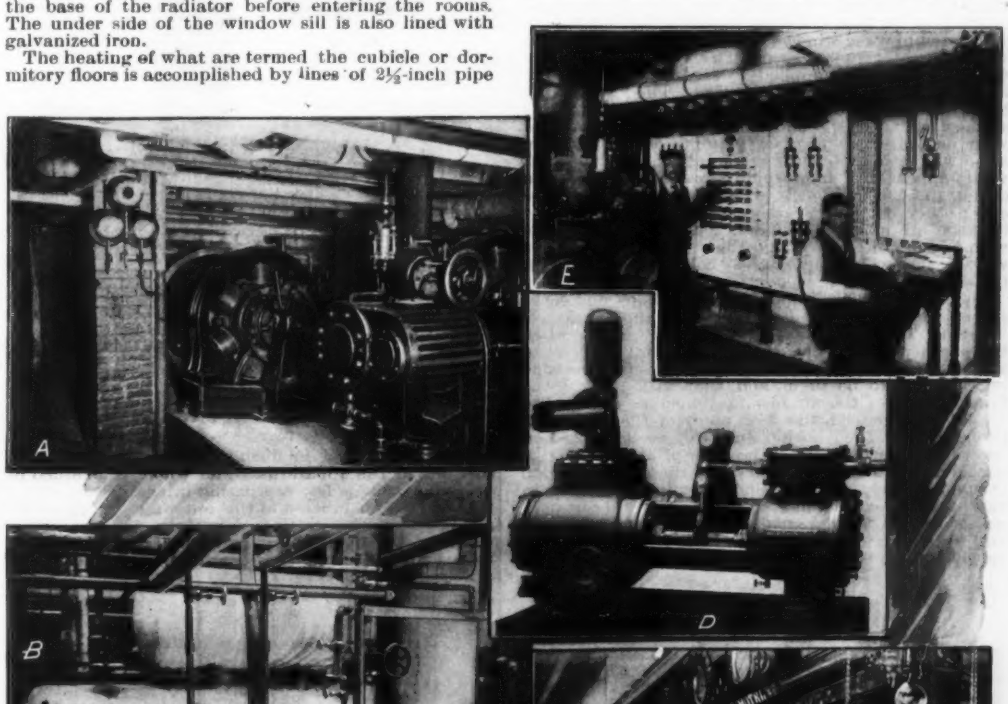


WASHING MACHINE.

EXTRACTOR.

MANGLE.

LAUNDRY EQUIPMENT, MILLS HOTEL No. 1.



A, engine room.
B, house and blow-off tanks.
C, boiler room.
D, house pump.
E, electrical switchboard.

LIGHTING AND POWER PLANT, MILLS HOTEL No. 1.

of the seats. The registers are connected to the main ducts in the stores by means of short branches passing under the seats through the floors.

Third.—That for ventilating the greater part of basement consists of two horizontal ducts along basement floor at rear of store cellars. One of these (that of "East" building) ventilates the restaurant, store cellars, stores and locker room.

The duct in "West" building ventilates the locker room, kitchen stores, stores, store cellars, engine and boiler rooms. A tight fitting clean-out door is placed in each duct at side of each fan. The discharge ends of the ducts are carried up under store windows and deflected.

For the exhaust system of ventilation seven 42-inch fans are used, one for each of the seven vertical shafts comprising system No. 1. They are set horizontally in the vent shafts in the lofts of the ninth story, and they are so located that every part of them is accessible through doors placed in the shafts. A wire screen or bar grating strong enough to bear the weight of a man is placed under them, near the level of the ninth story ceiling. In addition there are two 30-inch fans, one for each of the discharge chambers in system No. 2. These are set in window openings of the discharge chambers, the part of openings not covered by fans being filled in with sheet iron. Besides the fans mentioned there are two 30-inch fans, one for each of the ducts along the basement ceiling for system No. 3. These fans are placed vertically in ducts and are carried on angle-iron brackets bolted to the masonry. A 30-inch fan is also used to discharge from rear of tower on tenth floor. This fan is placed in a circular opening in the masonry provided for it. All of these fans are directly connected to electric motors, which are series wound for 110 volts.

The 42-inch fans are guaranteed to discharge 1,630 cubic feet of air per minute when running at 600 revolutions per minute, each 30-inch fan delivering 7,900 cubic feet at 800 revolutions per minute when connected up to all ventilating ducts with all registers open. Davidson fans and Lundell motors were used for the exhaust ventilating system.

For the purpose of properly preserving meats and provisions the hotel is provided with an absorption refrigerating system, the brine circulating in the engine room, where the temperature runs up to 138 degrees, at a temperature of about 7 degrees above zero. The refrigerating apparatus is also used for cooling the drinking water used in the restaurant, courts, and writing room, the water being thoroughly filtered before use.

PREVENTING CONDENSATION ON WINDOWS.

The prevention of "frosting" or steaming on shop windows appears to have been a favorite subject for inventors. The Patent Office records show a large number of such inventions, the majority of which are, however, systems of ventilation, of little or no practical value for either removing or preventing condensation on window surfaces. Among other curiosities the inventor employs a window of double plates of glass with hot water in between. The system now before us has been already applied to several shop windows in London, and is giving satisfaction. The "steaming" of shop windows, of course, takes place on the inside surface, the air of the shop being warm and charged with moisture, the window presents a cold surface, upon which this moisture is condensed. From this it would appear that shop windows would always steam during the cooler months, which we know is not the case; other conditions are necessary—namely, either that the air inside the shop is loaded with moisture within a few degrees of the dew point, or that the window surface is many degrees colder than the air in the shop.

The first condition obtains in tea-shops and cook-shops, consequently these windows almost always "steam." The second condition, which occurs when the weather is very cold, causes almost all windows to steam. To consider an example: Suppose the outside temperature to be 30° F. and that inside 60° F. the inner surface of the window may then be assumed to be 45° F. Now, let the dew point of the air in the shop be 50° F. then no moisture will be condensed on the window surface unless the layer of air next to it is cooled down to 50° F. or below. If the air in the shop is comparatively still the windows will steam, since in this case a layer of air next to the window will certainly get cooled to 50° F.; it will then deposit moisture, and by reason of its greater density it will sink down slowly and make room for other moisture-laden air,

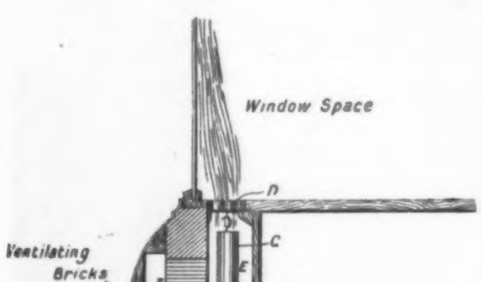


Fig. 1.

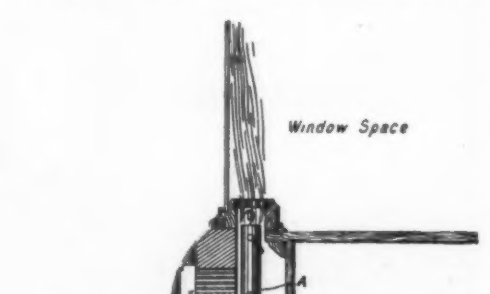


Fig. 2

which in turn will be cooled to 50° F. or below, will deposit more moisture, sink and make room for fresh moist air, and so on. It is for this reason that enclosed windows steam so badly, viz., because the air in them is still. The appliance of the Vapor Preventer Company provides a current of heated air next to the inner surface of the window, forming a kind of air curtain or screen between the window surface and the moisture-bearing air of the shop. For large shops with frontages of 100 feet or more a blower is used, and an air main laid on to all the windows. Suitable valves

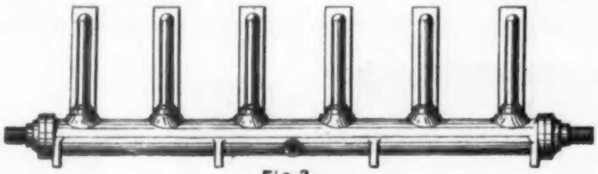


Fig. 3.

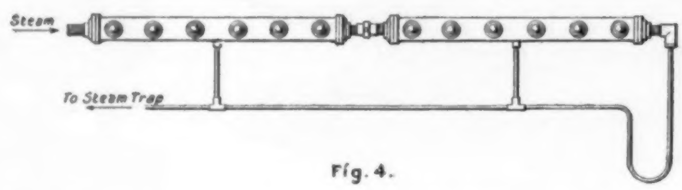
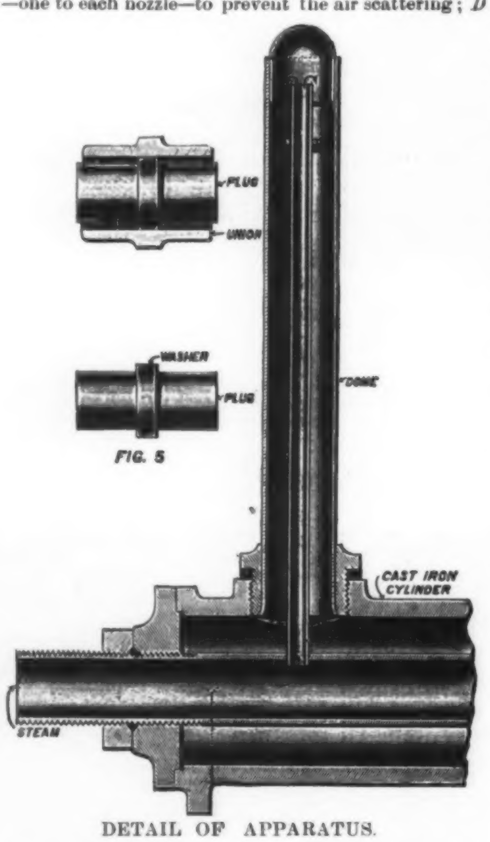


Fig. 4.

are provided to admit the air only to the windows which at any given time show signs of steaming.

Fig. 1 shows in section the arrangement for delivery. A is the air main delivering warm air under pressure; B is one delivery nozzle, of which there are about two per foot run of window frontage; C is a directing tube—one to each nozzle—to prevent the air scattering; D



DETAIL OF APPARATUS.

is a fine grating let in flush with the stall board and covering in the apparatus. The whole is boarded in dust-tight, but a few ventilating bricks communicate between the chamber and the outer air. Little or no air passes up the grating unless the air pressure is admitted, when a sharp current of dry, warm air rushes up the window surface and quickly dries up any moisture thereon. When the window is bright again—the clearing process taking from five to ten minutes—the air supply may be turned off. Most of the air admitted being warm, no unpleasantness is felt in the shop, and the temperature is not reduced. The nozzles are very fine, so that the volume of air sent into the shop is trifling; moreover, it is clean, warm, and dry, preventing injury to goods by the condensation of moisture. As before stated, this type of apparatus is only applicable to large shops, for although the piping, nozzles, etc., are inexpensive, the cost of one blowing and heating apparatus has to be included, and unless this does duty for upward of 100 foot the cost per foot becomes considerable.

For smaller premises the company supplies an apparatus working by means of an induced draught. This apparatus is of two kinds, namely, electric and steam. The electric apparatus is shown in Fig. 2. The tube A contains a resistance coil, and is so constructed that the air passes through it in two parts, the central core—the hottest—through the resistance, and the outer concentric layer, the less hot, outside the resistance, but inside the retaining tube. A row of these tubes 8 inches apart will clear a steamed window in twelve minutes. For windows other than cook shops this apparatus is economical.

A window having 16 foot frontage—quite a broad window—requires ¼ B. T. unit of electricity to clear it once; and since the expenditure of energy is not needed more than, perhaps, fifty times in the course of a year, it will be seen that the cost of current is trifling.

Fig. 3 shows a side elevation of one section of the steam appliance, and Fig. 4 is a section of the end to a large scale. This apparatus is fitted up in a similar manner to the electrical shown in Fig. 2; it is made in sections of about 4 feet, and connected up to the desired length by means of the union joint shown in Fig. 5. One section consists of a cast-iron cylinder 3 inch diameter, provided with a cover at each end and secured by means of a length of pipe, which passes through the cylinder. This pipe is screwed for a few inches at each end, right hand thread one end and left hand thread the other, and is tapped at intervals of about 8½ inches to receive short lengths of small bore copper piping open at the top and covered in by means of a dome secured to the cylinder; it is, therefore, obvious that steam being admitted to the central pipe finds its way up the small vertical pipes into their respective domes all the way along the apparatus, thus heating the domes, which in their turn are covered with a thin casing of metal somewhat larger in diameter. These are perforated at the bottom to admit the air, which is heated by the domes and passes up under the grating, as before described. The action is perfectly silent. Several of these installations are at work, and others are in progress. As the steam is taken off in existing boilers, the cost of working is practically nil. The Vapor Preventer Company, Limited, has offices at 68 Victoria Street, Westminster.

We are indebted to The London Engineer for the engravings and description.

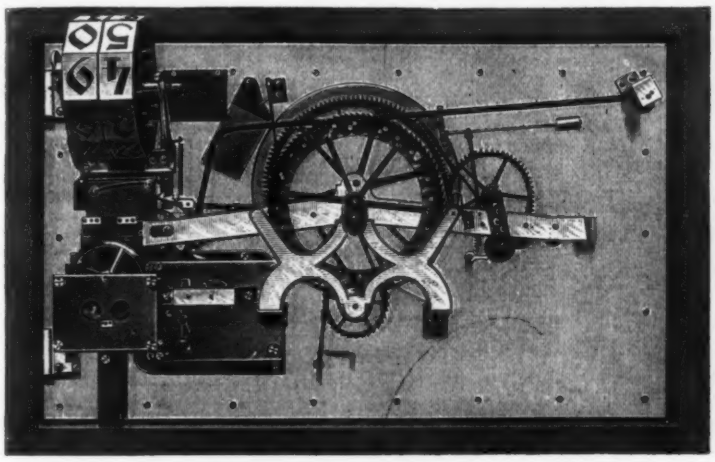
THE POROSITY OF VULCANIZED RUBBER.

When rubber wares turn porous during the process of vulcanization, we think in general of water or of gases which have formed in the substance. Though these two causes cannot explain all cases, it will often be found that water has been at fault in some way. We have, however, J. B. Höhn points out in the Gummi Zeitung, to distinguish two kinds of pores. The pores may be noticed in the interior of the mass, or be confined to the surface. In the latter case water will generally be the culprit. It is the condensed steam and the unequal action of the drops which we have to guard against. If the article is packed with French chalk, and water squirted on it, little spherules of chalk and water will form, and where these bear against the surface, the vulcanization will be interfered with and the surface appear corroded. If we wet the chalk uniformly and then allow drops of water to fall on it, these drops will be absorbed, but without doing any damage. If the article is wrapped with something or encased, the pores on the surface will only appear in spots where water drops can gain access. The pores in the interior owe their origin to a different cause. Any rubber, vulcanized at higher temperature without applying pressure, will develop pores. When several layers are placed on the top of one another, a little air bubble will be kept back somewhere, and we shall find pores afterward. The rubber contains atmospheric air; the kneading would introduce it if it were not already present. This air is probably responsible for the oxygen of rubber analyses, and it must produce pores when it has a chance to escape. If the vulcanization is properly conducted there will be no such chance, for the pressure within and without the rubber will be equally great. But if we release the pressure, the inner air will begin to expand, particularly when, near the end of the reaction, the rubber has become soft. It is for this latter reason that in unevenly vulcanized wares the inner unvulcanized parts appear porous, while the completely vulcanized outside is free of pores. To avoid this, it is only necessary not to open the escape-valve before the vulcanization and the cooling are finished. Sometimes it is even advisable to admit fresh steam

toward the end of the reaction, in order to increase the outer pressure, and to let the closed chamber cool completely before releasing the pressure.

THE PERPETUAL CALENDAR IN THE REICHSTAG.

THE accompanying engraving, for which we are indebted to The Guten Stunde, shows the interior of the perpetual calendar in the reading room of the Reichstag. The rectangular front plate of this calendar, which forms a gold background for the various dials, is decorated with figures symbolizing day and night, the sun and a butterfly for day and a comet and a bat for night. The hand that moves over the central dial



THE PERPETUAL CALENDAR IN THE REICHSTAG.

for indicating the days of the month is operated by the ratchet wheel shown below the large toothed-wheel in the center of the engraving, the latter being connected with representations of the moon and stars in gold on a light blue ground, which move behind an opening in the front plate that is provided on its lower edge with two semi-circular projections arranged to form the crescents of the new and old moon. On these projections are delineated the sun and comet above referred to. At the right and a little higher than the disk on which the days of the month are indicated, is another, on which the days of the month are marked, and the pointer that moves over this dial is operated by the toothed wheel at the right of the illustration. The wheel for operating the indicator on the dial giving the months of the year, located on the left of the front plate in a position corresponding to that of the dial giving the days of the week, is hidden by the apparatus for operating the calendar and that for indicating the year until 1999, the numerals appearing back of an opening in the front plate. Back of a corresponding opening in the upper left hand corner of this plate the permanent date of the construction of the Reichstag building, 1894, is placed. By simply changing these numerals for indicating the year, at the end of the century, this calendar can be used for an indefinite period of time.

All the clocks in the Reichstag are driven electrically from one master clock which closes a contact each minute, so that at each contact the hands of all the clocks move forward one minute. By an ingenious arrangement this contact is utilized also for operating the perpetual calendar, but as the dials and hands are necessarily large because the calendar is placed at a considerable height, and furthermore, all the indicators must be moved at the same instant, at midnight, the lever for accomplishing this object must be so long and heavy that the small amount of driving power is not sufficient to operate it. This difficulty the constructor, F. L. Löbner, of Berlin, has overcome by means of an auxiliary spring movement contained in the small casing shown at the left of the illustration, which raises the controlling lever and thus operates the corresponding wheels.

CABINET-MAKING SCHOOLS IN GERMANY.

CONSULAR reports of recent years contain a great deal of information on the subject of technical and industrial schools in Europe, and they clearly show that Germany easily takes the lead in the matter, by annually appropriating large sums of money for instruction in almost every art and industry. It is generally recognized that the commercial progress throughout the country depends largely upon the condition of technical education. Besides the many schools for agriculture and commerce, the system of special schools for other purposes is wonderfully complete. The tailors, the painters, the shoe-makers, the bakers, the smiths, the brewers, the butchers—each trade has its schools for theoretical and practical training. The United States Consul at Bremen states in his last report that he recently discovered at Magdeburg a school that roused his interest to an unusual degree. Though familiar with educational work in Germany, and also with technical schools, he says that he has never yet seen such an institution. This school was founded by a citizen of Magdeburg—a plain mechanic, a cabinet-maker, but a genius at his trade. After having been prosperous in business, he wished to aid young men apprenticed to the trade of furniture making in his native town. Under Prussian laws youths who, after having passed through the public schools intend to learn a trade, are required to continue attending a school for some nights during the week and for two hours on Sunday. Such schools are called "Fortbildungs-Schulen," a term signifying a school where the education is to be continued. The founder of the cabinet-making school had, through his own long experience, become convinced that such schools could not accomplish his purpose satisfactorily, because boys at the age of from 14 to 17, after being hard at work all day long, cannot be in a condition, either physically or mentally, to attend school for hours with any benefit to themselves. He, therefore, conceived the idea of establishing the school referred to. To accomplish his object, however, he needed the assistance of the Magdeburg union in the line of cabinet making, sculpturing, and wood carving, and their co-operation was granted to him to the fullest extent. All the head mechanics of the cabinet-makers, though most of them are men without any means, and therefore can ill afford to lose their time, agreed to send each of their apprentices to this school for a whole forenoon in every week, and also to take turns in assisting in the work of teaching. Consul Diederich says: "I believe it is impossible to conceive of anything more practical than the teaching in these classes, of which there are three, as it is a three-years' course. No question is put, no fact explained, no definition given, and no drawing made but has some bearing upon either the materials or the tools, or the purposes of the combined trade mentioned above. Great stress is laid upon freehand drawing, as this is to give the young men not only all the technical knowledge needed, but also to train the eye and the mind in designing every part of the various styles of furniture as well as artistic decorations in wood carving and inlaid wood work." The attention of the Government, both municipal and national, is now being called to the importance of this work, and it is hoped that the institution will soon be placed on a sounder financial basis. It is anticipated that this school, if properly supported and wisely conducted, will in course of time build up in Magdeburg an industry which will give employment to hundreds of artisans and mechanics, and bring renown to the city for its manufacture of fine artistic furniture, as Dresden is noted for its fine chinaware, Munich for its works of art, and Leipzig for its great book mart.—Journal of the Society of Arts.

MACHINE FOR PICKING MACADAM ROADS.

AMONG the qualities of a good road are solidity of structure and hardness of surface, both of which are to be found to an eminent degree in the "macadam" road, so called after its inventor, Mr. John Macadam. The macadam road, however, has the defect of requiring a careful, and, consequently, costly maintenance, if it be desired that its surface shall be kept in good condition and continue to offer its characteristic qualities. Such maintenance, as is well known, comprises a "picking up" (as it is called) of the surface with a tool, the object being to loosen the stones and sand forming the roadbed, so that new material may be intimately incorporated with the base upon which it is spread. This work, which is done with a pick, is performed slowly and imperfectly, and, as the solidity of the macadam depends absolutely upon it, a great advantage would be gained if the operation could be performed mechanically. So, in England, the country of macadamized roads, an endeavor has been making for some time to devise machines for practically obtaining such a desideratum. Machines of this kind are called "scarifiers," and various manufacturers, such as Messrs. Fowler, Aveling & Porter, Burrell & Sons, and others, have already constructed and exhibited various types of them at the agricultural competitions that are held periodically in England.

We illustrate herewith a machine of this class that was exhibited last year at the Maidstone competition. It was devised by Mr. H. Hallock and constructed by the Burrell establishment. As may be seen, it somewhat resembles an ordinary road-roller, and, in fact, is capable of being used as such when occasion requires it. An examination of the right hind wheel, however, will show what gives it its peculiar character and permits it to play the part of a scarifier. Suspended from the axle of this wheel, and partly embracing it, there is a triangular metallic frame capable of oscillating around a pivot at its upper angle. At each of its lower angles there is a scarifying tool formed of sharp steel teeth, which pick up the surface of the road in the same manner as does the hand-pick through percussion. This triangular frame is provided with two sets of teeth in order that the machine may operate in both directions without turning around. The frame is lowered on one side or the other, according to the direction in which the machine is moving. This operation is performed by means of the toothed sector, seen at the side of the machine, and which is connected with the frame through a jointed arm, and is controlled by a rod carrying an endless screw. This rod can be revolved by means of two winches, one behind and the other very near the sector.

For the above particulars and the engraving we are indebted to La Nature.

THE HOSACK SCARIFIER.

IRON AND STEEL RAILS IN AMERICA.*

By ROBERT W. HUNT, M. Am. Soc. C. E.

As America came to Great Britain for the rails used on her first railroads, it is perhaps fitting that this paper should be presented to the Society in London, and at its first English meeting.

The facts relating to the introduction of rails into the United States, and, later, their manufacture in that country, are historically recorded, and will only be briefly referred to herein. In obtaining the data, free use has been made of James M. Swank's valuable work, "Iron in all Ages."

The first charter for a railroad in the United States was granted by the Legislature of New Jersey in 1815, but the road was never built. In April, 1823, the New York Legislature granted a charter to the Delaware and Hudson Canal Company to construct a canal and railroad for the transportation of coal from the anthracite coal fields of Pennsylvania to the Hudson River. The road was 16 miles long, but was not completed until 1829. It was on this road that the first locomotive was run in America.

On Saturday, August 8, 1829, the "Stourbridge Lion," built in England, and weighing 6 tons, made its first trip; but its active life was short, as it was found to be too heavy for the superstructure of the road.

The first American-built engine was operated on the Baltimore and Ohio Railroad, in August, 1830. It was named "Tom Thumb," and was designed and constructed by Peter Cooper, who was somewhat restricted as to materials, as he had to use gun barrels for tubes. The whole machine weighed but 1 ton, and burned anthracite coal. The experiment was successful, and, based on it, later machines were designed and built; the first one of practical size and use being the "Best Friend of Charleston," which was constructed at the West Point Foundry in New York city, for the Charleston and Hamburg Railroad of South Carolina. It went into active and successful use on that road in December, 1830.

Only some five years intervened between the opening of the first railroad in the world intended for general

* Read before the American Society of Civil Engineers, London meeting.

freight and passenger service—the Stockton and Darlington—September, 1825, and that of the first one in the United States for the same purposes—the Baltimore and Ohio. Its construction was begun on July 4, 1828, and "cars were put upon it for the accommodation of the officers, and to gratify the curious by a ride," in 1829; but it was not formally opened for travel until May 24, 1830. It was then 613 miles long, extending from Baltimore to Ellicott's Mills, Md.

Thus, in railroad building, as in many other things, the Americans were early disposed to follow closely after their English relatives; and perhaps, like other younger people, were soon not satisfied to follow, but aspired to lead. Thus, the next passenger railroad to be constructed was the Charleston and Hamburg, already mentioned. This was opened for public use in December, 1830. In September, 1833, it was completed for a distance of 135 miles, and was "the longest continuous line of railroad in the world."

The nucleus, from which later came the great New York Central and Hudson River Railroad System, was the Mohawk and Hudson Railroad, chartered by the New York Legislature in 1829, but not begun until 1830, and opened for travel in 1831. It extended from Albany to Schenectady, 17 miles.

There were some earlier railroads, or more properly tramways, built in the United States, but those named were the first really commercial roads.

The rails used on these roads were of wood with flat bar-iron nailed to the upper surface. The track of the Baltimore and Ohio Railroad is described as consisting of "cedar cross-pieces, and of string-pieces of yellow pine from 12 feet to 24 feet long and 6 inches square, and slightly bevelled at the top of the upper side for the flanges of the wheels, which at that time was on the outside. On these string pieces iron rails were placed and securely nailed down with wrought iron nails 4 inches long. After several miles of this description of road had been made, long granite slabs were substituted for the cedar cross-pieces and the yellow pine stringers.

"The iron used for rails was ½ inch to ⅝ inch thick by 2½ inches to 4½ inches wide. The heads of the nails or spikes holding it down were countersunk in it."

One would judge, from the varying thicknesses and widths, that the specification and inspection were not very rigid.

Notwithstanding these strap-rails being "securely nailed down," it was found that traffic would loosen them, with the final result of their turning up as the wheels passed over them, and forming what were called "snake heads." These would occasionally tear through the bottom of the cars and cause more or less inconvenience if not danger to the passengers. So the American engineers again turned to England, where the same difficulties had led to the invention of rails of different sections. It is believed that the first one was the fish-bellied rail, invented by John Birkinshaw, of the Beddington Iron Works, and patented in October, 1820. This rail was held in cast-iron chairs by side keys or wedges. The Baltimore and Ohio Company soon afterward imported some of these rails.

The Stockton and Darlington, and its follower, the Liverpool and Manchester, which was opened in September, 1830, were principally laid with rails of the Birkinshaw type. The Stockton and Darlington also had a few cast-iron fish-bellied rails.

The Clarence rail was another English invention, and was considered an improvement on the Birkinshaw. Rails of that pattern were imported into America for the Allegheny Portage Railroad, built by the State of Pennsylvania over the Allegheny Mountains to connect the canals on either side of them. This road was opened in 1833.

In 1834 the Columbia and Philadelphia Railroad was opened. Part of this was laid with flat rails, but on the greater part the Clarence rails were used. On both roads the rails rested on stone blocks. These roads were in after years absorbed by the Pennsylvania Railroad.

Another English section was the H-rail, which rested in a chair. These were imported and used on some of the roads. Still later came the U-rail, known in Wales as the Evans patent, and believed to have been first rolled at the Dowlais Works.

Some of the flat strap rails were made in America, but all the sectioned ones were imported. Some attempts were made to use American cast-iron rails, but with unsatisfactory results. It was not until 1844 that the manufacture of sectioned wrought-iron rails was begun in America. A rolling mill was built in 1843 by the Mount Savage Rolling Mill Company, at Mount Savage, Allegheny County, Md., expressly to make rails. Operations commenced in 1844, and for their first rail, which was of the U-section, they were awarded a silver medal by the Franklin Institute of Philadelphia. The rail weighed 42 pounds per yard. About 500 tons were laid in 1844 on the road then being built between Mount Savage and Cumberland, Md. A short time later they rolled some 52 pound rails for a road between Fall River and Boston, and in 1845 and 1846 they rolled T-rails. This mill, after being long abandoned, was finally dismantled in 1875.

The T-rail was generally known in Europe as the "Vignoles" rail, after Charles V. Vignoles, an English railroad engineer, who introduced its use there. But it was really invented by Robert L. Stevens, of Hoboken, N. J., president and engineer of the Camden and Amboy Railroad.

In 1845 the Montour Rolling Mill, at Danville, Pa., was built expressly to roll T-rails, and in October of that year there was rolled in that mill the first rail of that section made in America.

In 1846 T-rails were rolled by the Boston Iron Works, Boston, Mass.; by Cooper & Hewitt's mill at Trenton, N. J.; by the New England Iron Company, Providence, R. I.; by the Phœnix Rolling Mill Company, Phœnixville, Pa.; by the Great Western Iron Company, Bradys Bend, Pa.; and by the Lackawanna Iron Works, Scranton, Pa.

In the following years the manufacture was taken up by other companies, but owing to the commercial conditions caused by the severity of foreign competition, early in 1850, only two out of the fifteen rail mills in the United States remained in operation.

Those early rails were all short—none over 15 feet long. As the difficulties of manufacture were overcome and the science of track-laying progressed, the length was gradually increased until 21 feet was reached, and was considered the limit. It was not until about 1859 that railway engineers would accept those of greater length.

The first 30-foot rails rolled in America were made by the Cambria Iron Company, Johnstown, Pa., in 1855; but they could not find sale for them, and they were finally used by that company in their mill yards. The first 30-foot rails to fill an order were rolled by the Montour Company in January, 1859, for the Sunbury and Erie Railroad Company.

The rolling of iron rails was attended with many difficulties. If the pile of bars was not heated to a sufficiently high degree, the welds would not be perfect; and if heated too highly, the iron would crack in the process of rolling and yield an imperfect product. If the metal was too soft, although the rail might be free from flaws and bad welds, it would wear out rapidly under traffic. Under all circumstances it was important that the rolling process should be completed as quickly as possible, so that the reductions should be made while the iron had lost little of its heat. This, together with some local conditions, led to the invention by John Fritz, Hon. M. Am. Soc. C. E., of the three-high rail train. Three-high sets of rolls had been used for many years in making merchant bars, but it required the application of the "Fritz yielding hanging guides and driven feed rollers" to make them practical for rail rolling. This improvement was put into successful operation at the Cambria mills in 1857. It has ever since remained as the typical American rail mill. Since the introduction of steel rails, there have been several two-high reversing mills on the English plan used in America; in fact, two of this kind are now running. But the three-high is the American mill, and has permitted the tremendous production which has been attained in later years.

The early mills required the work of handling the material as it passed through the rolls to be done by manual labor, through the use of tongs and hooks. Probably the rolling of iron piles, with their necessarily peculiar handling, would have indefinitely continued this, but with the use of solid steel blooms the troubles lessened and made possible the introduction of automatic machinery. The tong-and-hook system necessitated the employment of fifteen to seventeen men, and the production of steel rails was limited to not over 250 tons per turn. Automatic machinery revolutionized this, both as to number of men employed and the possibilities of production.

It was the writer's fortune to introduce the first driven rail-mill tables, those in the works of the Albany and Rennselaer Iron and Steel Company, Troy, N. Y., in March, 1884. These were in front of the finishing rolls, and worked so well that an automatic arrangement was soon after placed in front of the roughing rolls. This latter arrangement was more particularly designed by Mr. Max M. Suppes, then the master mechanic of the works, and now the general manager of the Lorain Steel Company, Lorain, Ohio. Naturally, these devices were protected by letters patent. From this start other inventions were made, and many improvements by other American engineers have followed, until the present American rail mill, capable of turning out 50,000 tons of finished rails per month, has been developed.

It was the writer's fortune to become connected with railmaking in 1856, and among his earliest recollections is the statement that the users of rails had in service certain makes which had been and were giving good results impossible to be obtained from any more recent manufacture. How familiar that statement must sound to many of you, and as of recent date!

Then, as now, the question demanded an answer, and many sought for the solution.

The first iron rails were made from straight puddled bars. These bars were about 1 inch thick and were placed one upon another, until a pile of sufficient weight and height was formed; the pile was then reheated and rolled into rails. And it was to the formation of that pile that inventive genius was applied.

From an investigation of the fracture of some of the rails which had given satisfaction, it was discovered that the pile of bars from which they had been rolled had been entered into the rolls edgewise, thus bringing the line of welds between the bars in vertical instead of horizontal position. This presented a different structure to the wheel wear, and seemed to be logical. Based on that supposition, many rails were so rolled, and the writer believes that the scheme was patented.

Where the rail was rolled with the layer of the pile in a horizontal position, particular attention was given to the character of the top bar, which would, of course, form the wearing surface of the rail. Cold-short or granular iron was used for it, while the remainder, or at least the flange of the rail, was of fibrous iron.

At one time a rail with a puddled steel head—or rather with the top bar of the pile of puddled steel—found much favor, but, owing to the difficulty of obtaining uniformly good welds, the results were not satisfactory. Some of these so-called steel-headed rails had the top bar of what was known as silicon steel.

Another plan, on which much money was spent, was to hammer a puddled ball, or weld two puddled balls together, under a steam hammer, and draw them into a slab 2 inches to 2½ inches thick, which was used on the top of the rail pile. Under an order from the Pennsylvania Railroad Company, the Cambria Iron Company, in whose employ the writer was then serving, erected a special steam hammer, and made several thousand tons of such rails. Their service was somewhat disappointing, and the practice was abandoned.

At that time, as since, commercial conditions controlled. The railroads had the worn-out rails on their hands, and, regardless of whether or not the practice would give satisfactory results, they adopted a system of having the old rails re-rolled into new ones. At first a certain percentage of new iron was specified, but as the necessities for immediate economies increased, that demand was eliminated from the contracts, and the new rails were composed entirely of the old ones. The best practice was to make a pile of old rails, break it down into bars, which were piled upon each other, and then rolled into rails. But presently this was found to be too expensive to successfully meet the cry for cheaper rails, and only the top and bottom of the piles were formed from re-worked iron, the center being composed of from three to six pieces of old rails.

From the many re-workings, the cheapening of the process of manufacture, and the increasing demands of traffic, the wear of the iron rails become more and more unsatisfactory, until it seemed as though, from that cause alone, the limit of railway development had been reached. Such situations frequently occur in earthly affairs; and seldom, if ever, has the occasion failed to be met by a solution of its difficulties. In this case it was the invention of Bessemer.

It is an historical fact that the first rail ever made from Bessemer steel was placed on the Midland Railroad, of England, early in 1857, at a point where iron rails had sometimes to be renewed within three months; and it remained there until June, 1873, some sixteen years, during which time about 1,250,000 trains and any number of detached engines and tenders passed over it.

We all realize that without such an innovation as Bessemer's, the subsequent tremendous expansion on railway development would have been physically impossible.

Railway managers were timid about using steel rails, and in America many attempts were made to produce a satisfactory rail having an iron base and web, with a steel-capped top. None was satisfactory, and the Bessemer steel rail soon conquered the situation.

The first steel rails laid down by an American railroad were imported by J. Edgar Thomson, president of the Pennsylvania system.

The first to be manufactured in America were rolled at the mills of the North Chicago Rolling Mill Company, Chicago, Ill., on May 24, 1865, from ingots produced in experimental steel works at Wyandotte, Mich. They were not many in number, and were made on the regular iron rail rolls of the mill. Several of the rails were put in local railway tracks and gave good service.

The first production of steel rails in the United States, on a commercial order, was at the Cambria Iron Company's mill, in August, 1867, from ingots made by the Pennsylvania Steel Company, near Harrisburg, Pa. The converting works of that company were completed some time in advance of its rail mill, which led to an arrangement under which the ingots were sent to Johnstown to be hammered into blooms, which were then reheated and rolled into rails. The steel was made under the mangement of the late Alexander L. Holley, M. Am. Soc. C.E., then in charge of the Pennsylvania Steel Company. George Fritz was the chief engineer and general superintendent of the Cambria Iron Company, and Alexander Hamilton superintendent of the rail and other mills, while the writer was in direct charge of the steel department.

It is a matter of some interest that the ingots were drawn down by the steam hammer which had been installed some years before to make the hammered iron slabs for the Pennsylvania Railroad Company's rails. From this time the production in America of Bessemer steel rails increased rapidly.

For a time after the starting of the Pennsylvania Steel Company's Bessemer Works, the ingots were cast from the top, on the then accepted English plan. Mr. Holley's mind was not so constituted that he could long follow any beaten track without an effort to do better work on some other line. Thus he introduced the bottom-casting of ingots: pouring the steel into a central octagonal mould about 14 inches in diameter at the bottom and 10 inches at the top, from the bottom of which the metal flowed through connecting gates into four surrounding moulds 8½ inches square. This plan was adopted after consultations with Mr. George Fritz, who had rolls turned to take the 8½-inch ingots. The central or sprue ingots were hammered into blooms. It was found that the small ingots rolled satisfactorily, while, on the contrary, the central ones cracked badly during working.

This led to much discussion and consultation among the operative officers of the Cambria Company and Mr. Holley, the result of which was that John E. Fry, then superintendent of the Cambria Iron Company's iron foundry, suggested the use of a rammed-up center sprue, 4 inches in diameter, connecting through fire-brick gates with surrounding ingots; the sprue and gates to be treated as scrap. This plan answered admirably.

While in charge of the experimental Bessemer Works, at Wyandotte, Mich., in the interest of the Cambria Iron Company, the writer had developed a manner of bottom-casting ingots. Mr. Holley, having protected his plan by a patent, Mr. Fry and the writer united in patenting theirs, and their interests and those of Holley were consolidated. For some years after this practically all bottom-casting of ingots in America was licensed under these patents. After a time the price of rails became so much reduced that the loss incident to the scrap of the center sprue and bottom gates made in bottom-casting became a serious matter; and while it was and is impossible to cast as sound, and hence as good, ingots from the top, the better plan was abandoned.

At first all the American Bessemer works pursued the English plan of reducing the ingots to blooms under steam hammers. This was so at the Pennsylvania and Troy Works. The success in rolling the 8½-inch ingots at Johnstown led to the invention of the American blooming mill, and this soon completely superseded the steam hammer in rail-making.

This idea originated with Mr. George Fritz. Holley and he were intimate friends, and exchanged views freely. Holley had severed his connection with the Pennsylvania Steel Company, and returned to the Troy, N. Y., Works. There he built a three-high blooming mill. While it had tables, their rollers were not power-driven, and the ingots had to be pushed into the rolls and turned over on the tables by hand. Soon after, George Fritz built a blooming mill at Johnstown, in connection with a Bessemer converting plant, and put into use his patented ideas of driven rollers, hydraulically-controlled movable rolls, and a "turning over and sliding from pass to pass" device, christened by the mill hands a "go-devil," which permitted the economic handling of larger ingots. This was the birth of the American blooming mill. In perfecting his plans George Fritz had the benefit of the advice of his brother John, then manager of the Bethlehem, Pa., Works.

Perhaps these details apply more to rolling-mill practice than to the rails themselves, but the writer

thinks that they have played a most important part in relation to the character of steel rails, and are pertinent to the subject. Holley started the innovation by which the production of steel ingots has been increased so greatly. Fritz gave the blooming mill, which would not only take care of all that was sent to it from the converting works, but, like Oliver Twist, asked for more; and the late Captain William R. Jones, Robert Forsyth, M. Am. Soc. C.E., and several others, built rail mills which were not satisfied with the amount of steel sent to them by any blooming mill. This has all been magnificent. It has made possible undreamed of low prices for steel rails. It has helped to build railroads, but has it improved the quality of the rails produced?

(To be continued.)

[Continued from SUPPLEMENT, No. 1283, page 20564.]

AMERICAN ENGINEERING COMPETITION.*

IV.—STEEL WORKS.

THERE are many large steel-making works in America, but the most important of all—that is to say, the most important in the world—is that known as the Carnegie Steel Company (Limited), whose different works are in or near Pittsburg, Penn. It will be understood, in reference to this, that the Carnegie Company is not a trust or a "combine," but is a homogeneous business that has grown up under one management from small beginnings. It is difficult to describe the gigantic interests and extensive properties of this company, its phenomenal growth and vast output of material, without appearing to use words so extravagant as to be out of place in dealing with a business-like subject such as that before us. Perhaps the best course to pursue will be to give briefly an account of the property of the Carnegie Steel Company.

There are three principal steel works, the Edgar Thomson, the Duquesne, and the Homestead Steel Works, all situated in, or close to, Pittsburg. In connection with these are—or were at the time of my visit, for they have increased since—17 blast furnaces, the aggregate annual capacity of which is 2,200,000 tons. The Edgar Thomson Works produces 800,000 tons of steel ingots, or 650,000 tons of rails a year. The Duquesne Steel Works will produce 650,000 tons of steel ingots a year, and the Homestead Works 400,000 tons of Bessemer steel ingots and 1,400,000 tons of open hearth steel ingots a year, or 1,350,000 tons of finished steel. At the Edgar Thomson Works there is also a foundry which produces 50,000 tons of iron, steel, and brass castings a year; this being the quantity it takes to keep the Carnegie works going. In the Upper Union Steel Mills of the company there are seven trains of rolls, which produce structural steel, steel bars, and plates to the extent of 250,000 tons a year. At the Lower Union Steel Mills there are four trains of rolls besides hammers, and here are made plates, car forgings, bridge work, angles, etc., to the extent of 150,000 tons a year. There are entirely new works, known as the Howard Axle Works, which have a capacity of 300 tons per day. The company has also most extensive coke works, and a natural gas field of 206 square miles. In order to be independent of railway companies the Carnegie Company has constructed a line of railway for its own use, extending from Lake Erie to Pittsburg. This line ends at an extensive and admirably equipped dock and ore-handling establishment at Conneaut on Lake Erie. The company has also iron mines producing 5½ millions tons of ironstone a year. These do not by any means exhaust the properties of the company, but they are the principal ones. How many millions of pounds or dollars they represent turned over in the year I do not know, and probably no one else does, exactly. At any rate, the sum must be colossal.†

To produce the vast bulk of material to which reference has been made, needs a plant the like of which exists nowhere else in the world. As has been said, there are three main works, and each is bigger in extent than anything of the same kind we have in England, while the output of the furnaces exceeds that of our own by an enormous extent. No doubt this is largely due to the superior richness of the American ore, a subject on which a few words will be said later on.

Although I had already a somewhat extended acquaintance with the Carnegie works, I devoted four days to walking through them. Every one connected with the place was perfectly willing to give all the information one could ask for. In this respect, however, both British and American steel-makers are generous to a fault. Something of the largeness of their operations seems to enter into their characters, and the stories that are told about rival firms helping each with information, often laboriously gained at great expense, are good to hear.

It is not proposed to give separate descriptions of each of the three big Carnegie works, but a few characteristic features may be selected from each. Four of the 17 blast furnaces owned by the company are at Duquesne. They are large furnaces, but would not strike an English ironmaster as being overwhelmingly large. They are, in broad principle, much as other blast furnaces. They are 100 feet high, 22 feet in diameter in what is called the "bosh" or widest part, and 14½ feet at the "hearth" near the bottom. Their capacity is 25,000 cubic feet. They were designed to produce 500 tons of iron per day, but often work up to 600 tons a day, an output far in excess of British furnaces; and even this has been considerably exceeded.

Speaking generally the practice of American blast-furnace managers is to force the production much more than we do in Great Britain. That, of course, is facilitated by the richer ore; for if there is in one ore, say, 60 per cent. of iron and 40 per cent. of gangue, which is slag-making material or refuse, it stands to reason that the furnace will make considerably more iron in a given time than if 60 per cent. of the ore is gangue and 40 per cent. only is iron. In each case the whole mass has to be brought to a molten state, and the larger the percentage of impurity the more coke is burnt for a given product of iron. That accounts to a large extent for the extremely high product of American furnaces as compared to our own. Beyond this, however, the Americans make a deliberate practice of driving their furnaces, as they expressively put it, "for all they are worth." In order to smelt ironstone the ore, the coke, and the limestone used for flux are charged into the top of the furnace. The coke burns, the iron melts out from the ore, and the waste matter combines with the limestone to form the product known as slag. What is the exact nature of the chemical reactions needed to produce the conversion is matter of controversy between authorities; but to get the necessary heat for these reactions a strong blast of air must be sent through the furnace. In order to produce this, blast-blowing engines of enormous power are used, the air being forced in at the bottom of the furnace through tuyeres, or short iron pipes, which are kept from melting by having a water circulation. The Duquesne engines, of which there are ten, are 40 feet high. They have cylinders up to 100 inches in diameter. Each is equal to the power that can be exerted by 1,800 horses and each will deliver 50,000 cubic feet of air per minute. The pressure of the blast is equal to 15 pounds to 18 pounds on the square inch, and it is raised by means of enormous stoves using the waste gases from the furnaces to a temperature of 2,000° Fah. The working of a blast furnace never stops. Year after year, from the time it is first lit or "blown in," there passes down its fire-brick "throat" this constant stream of ore, coke, and flux; a thousand tons a day. The red-hot breath from the blowing engine rushes upward and meets the molten stream without ceasing, until at last the mighty digestion is worn out, after gorging perhaps a million tons, and the furnace is blown down for a new lining.

The economics of the blast furnace depend largely on how long it will take to bring a lining to the condition of being too thin to work, and in this respect the practice of British and American ironmasters differs materially. The largest Middlesbrough furnaces have a capacity of 36,000 cubic feet, which is, it will be seen, considerably above the content of the Duquesne furnaces. But the English furnaces only produce 950 tons of Cleveland pig iron a week per furnace, as against the 4,200 tons a week of the Americans; although even this figure, as already stated, has been exceeded, for the Duquesne furnaces are said to have worked up to 700 tons a day per furnace, or 4,900 tons a week. The hard driving to which Americans resort, as might be expected, means a short life to the furnace. I did not hear how often the Duquesne furnaces are relined; but Mr. Archibald P. Head, an English engineer who has paid considerable attention to the iron and steel practice of both England and America, gives some figures as typical. He says the lining of an American furnace, working, however, at lower blast pressure than the Duquesne furnaces, lasts four years; in one case the lining of a British furnace lasted 18 years.

The Americans, however, do not estimate so much on the time a furnace lining will last as on the iron it will produce, and that undoubtedly is the more rational mode of calculation. "We hold," they say, "that a lining is good for so much pig, and the sooner it makes it the better." In the case quoted by Mr. Head, however, the American four-year furnace only produced 270,000 tons of pig, while the English furnace passed out 500,000 tons of iron from a lean ore. In spite of this greater cost of lining per ton or iron produced of the American practice (and it is a very costly business to line a furnace) the ironmasters of the United States believe in hard driving. They want to make plenty of iron to keep their mills going, and look on it that a little loss in furnace lining is more than repaid by savings in other respects. The policy may be open to question, and, as Mr. Head suggests, the striving after large outputs may be due rather to rivalry between furnace managers than to considerations of economy. Still, the Americans have their great success to point to as their justification.

As to the advantage of another characteristic feature of American blast furnace practice there can be little question. Nothing seemed to me more notable at the Duquesne works than their loneliness. Had it not been for the subdued hum, characteristic of a furnace in blast, and the rush of waste water from the tuyeres, one might have thought the works were shut down. This is seen, more or less, throughout the United States, where great effort is made in all productive industries toward the replacement of human labor by mechanical appliances. From the humblest kitchen to the mammoth factory—from peeling apples or washing plates to heaping tons of coke and ore into a blast furnace—the American always strives to do what he can by machinery; and the inevitable consequences are that labor is better paid and that there is more demand for it than in any other country. "For anything that can be done without thinking we want to use a machine, so that men can be set free to work the best part of them, their brains." That is the position taken by the American. It is this that chiefly accounts for the apparent anomaly of high wages and cheap labor—that is, cheap in terms of the product.

In the production of steel ingots, rails, plates, etc., from the mine to the mill, the labor-saving principle has been fully carried out. The mining engineer, the metallurgist, the naval architect, and the mechanical engineer have combined to treat a part of the earth's surface as if it were a vast labor-saving machine. Here is so much ore in Minnesota or Wisconsin, how best can we put it into railway trucks as rails or plates at Pittsburg, Chicago, or Cleveland? It is just the same as if there were a bale of cotton to turn into a roll of calico; and, just as the cotton manufacturer no longer thinks of combing by hand, spinning by wheel, or of pushing a shuttle between the warp with his fingers, neither does the American ironmaster expect his ore to be dug up with spades or to be wheeled in barrows; nor, in fact, does he expect any direct hand labor to be devoted to the whole process of manufacture throughout—the single exception being the filling of the buckets which take the ore out of the ship, for which spade work is employed.

It has already been said that the Lake Superior ores, from which the steel made in the United States is largely produced, are much richer in iron than the ores used in this country. Not only is that the case, but they are also generally much easier to win. A great deal which lies in immense masses on the slopes of the hills is covered only by a thin layer of surface soil easily removed. Railway lines are then laid down, and there is brought into position a steam shovel, which is similar in principle to our "steam navvy," but is larger and more powerful. With these most puissant diggers five tons can be lifted at a shovelful, so that five strokes will fill a 25-ton railway wagon. Mr. Head states that he has seen trucks filled in this way at a rate of 600 tons an hour. Two men and four cwt. of coal will do the work. All the ore is not gained in this easy manner, however, even in the Lake Superior district, and there are a good many mines, properly so-called, where the mineral has to be won from underground. It will give an idea of the advantage of working so directly on the surface to state that the Mesabi ores, which are those worked by the steam shovel, are put on the wagons at 10d. per ton, including all costs, while with some other ores the corresponding cost is 4s. 2d. per ton. There is, however, another side to the question. The Mesabi ore is so easily shoveled up because it is of a pulverent nature, but for the same reason it would choke the blast furnaces were it not mixed with other more coherent ironstone. Writing before the present great rise in prices, Mr. Head said that "but for the Mesabi competition 20s. per ton at Pittsburg would still be the cost of Lake Superior Bessemer ores instead of a little more than half that price."

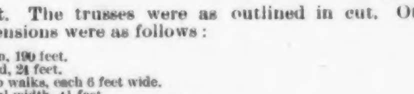
The mines are at varying distances from Lake Superior. For instance, the Marquette mines are fifteen miles from Marquette Harbor, and the cost of transit by rail is 1s. 4d. per ton. In another instance, that of the Gogebic mines, the cost of transport to the lake is 2s. per ton. The Mesabi deposit is seventy-five miles from the ore docks, and the transport by rail costs 3s. 4d. per ton. These figures are taken from Mr. Head's paper read in February, 1899, before the Institution of Civil Engineers, a contribution to the literature of the subject which those interested may study with advantage. Mr. H. N. Winchell, in a communication made to the Federated Institute of Mining Engineers two years ago, stated that the capital then invested in Lake Superior mines was £50,000,000 sterling, and that in the Mesabi range alone there are in sight 400,000,000 tons of iron ore. The aggregate production of ore by the Lake Superior mines was 12,500,000 tons a year.

* This series of articles on American Industries was written by an expert of The London Times, who made an extensive trip through this country in order to prepare the articles, the first of the series being published in the SUPPLEMENT of July 21.

† Since this was written some interesting particulars of the operations of this firm have been made public in consequence of the threatened litigation between Mr. Carnegie and Mr. Frick. It appears that in 1898 the profits of the company were $21,000,000, and in 1899 they were either $40,000,000 or $42,000,000. That is to say, the firm made over eight million pounds sterling at the lower estimate last year. As Mr. Carnegie owns more than half the property, his income from the business alone amounted to between four and five millions sterling last year. See Engineering, February 23, 1900.

COMPARATIVE COST OF COMBINATION AND ALL-STEEL HIGHWAY BRIDGES.

THE bridge in question was designed for the Pacific



coast. The trusses were as outlined in cut. Other dimensions were as follows:

Span, 190 feet.
Road, 24 feet.
Two walks, each 6 feet wide.
Total width, 41 feet.
Depth of truss, 27 feet to 33 feet.
Wood joist.
Floor, 4-inch wood block paving on 3-inch plank.
Uniform live load on floor = 100 pounds per square foot.
Concentrated live load on floor, 15-ton roller, or two electric cars on each track.
Live load per foot of bridge = 3,300 pounds.
Dead load per foot of bridge, 2,345 pounds.
Trusses pin connected.

For the combination design hard pine was used for top chords, web posts, portals, lateral struts, floor-beams and joist. Remaining parts were of steel.

The estimated quantities for this case were:

Eye bars	42,180 pounds.	
Cast iron joint blocks	19,720 "	
Lateral rods	5,810 "	
Machined work	5,940 "	
Shoe plates	5,200 "	
Loops	3,160 "	
Hangers	1,240 "	
	83,250 "	Cost = $3,130
Hard pine chords and posts	17·50 M.	
" " lateral struts	3·08 "	
Floor plank	19·74 "	
" joist	22·24 "	
" beams	14·80 "	
	77·36 "	Cost = $2,400
Paving 504 square yards		" = 750
Fence, 400 feet		" = 200
Erection		" = 1,300
Total cost of combination span		= $7,680

This cost is about $1 per square foot of total floor.

For the all-steel design the quantities were:

Steel	180,000 pounds.	Cost $7,300
Floor plank	19·74 M.	" 1,435
Wood joist	22·24 "	
Fence, 400 feet		" 200
Paving, 5 4 square yards		" 750
Erection		" 1,300
Total cost of steel span		= $10,945

This cost is $1.43 per square foot of total floor.

The above comparison applies to whole superstructures complete.

Compare now the cost of substituted parts only.

In combination design, the top chords, web posts, portals, lateral struts and floor beams contain:

Hard pine, 35·3 M. at $35 per M	= $1.220
Cast iron joint blocks, 19,700 pounds, at 3c.	= 591
	$1,811

For the all-steel design, the same parts contain:

Steel, 118,200 pounds, at 4c. = $4,720

Summarizing, we have:

Combination bridge cost	$7,080
Steel bridge cost	10,945
Combination chords, etc., cost	1,811
Steel chords, etc., cost	4,720

Hence we may say, roughly, that the combination bridge cost one-third less than the steel one.

Also that the comparative cost of wood (including necessary cast blocks) and steel for top chords, web posts, portals, lateral struts and floor beams, is as one to three.

H. G. TYRRELL,
Assist. Engineer Boston Bridge Works.

THE PAVILION OF GERMANY AT THE PARIS EXPOSITION.

The German pavilion occupies an important position on the "Street of Nations" on the bank of the Seine. It is located between the pavilions of Norway and Spain; it has been aptly called a "synthesis of ancient and modern German architecture." It reminds one very much of the picturesque decorations of Rhenish towns and of the houses of Nuremburg, although at the same time it shows the more modern influence of Berlin and Munich. The façades are all different, they have a rich and solid appearance, and are divided by gables of various shapes, edged with open stone work. The west façade is composed of two parts—a high tower, and at the side, the front of an old German house. The building is covered with tourelles and clock towers. The principal entrance is from the street and it gives access to a large hall. The walls and ceilings have been decorated with symbolical paintings, representing the career of man from youth to old age. The windows are filled with fine stained glass. In the center of the hall is a bust of the Emperor. On the tribune, facing the staircase, is an orchestra, and above is a stained glass window representing Germany waving palms of peace. There are also rooms devoted to the exhibition of German books on photography, printing, etc. The first floor is reached by a double staircase of marble and wrought iron. It is a marvelous piece of workmanship. There are also rooms on this floor devoted to the printing trades. Three rooms are devoted to Frederick the Great and are decorated in the same style as the rooms at Potsdam. Valuable little masterpieces of painting of the eighteenth century are exhibited in these rooms. On the quay is a café restaurant. For our engraving we are indebted to The Monde Illustré.

THE PAVILION OF GERMANY AT THE PARIS EXPOSITION.

THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.

The ultimate execution of this important enterprise is now assured, says Nature. Every one was of opinion that if a fair beginning can once be made, the importance of the work is so great—it will be of such use to scientific workers at large—that it will rapidly grow in favor and soon secure that wide support which is not yet given to it simply because its character and value are but imperfectly understood. Therefore, all were anxious that a beginning should be made.

It has been estimated that if 300 sets or the equivalent are sold, the expenses of publication will be fully met. As the purchase of more than half this number was guaranteed by France, Germany, Italy, Norway, Switzerland, and the United Kingdom, the Conference came to the conclusion that the number likely to be taken by other countries would be such that the subscriptions necessary to cover the cost of the catalogue would be obtained.

The resolution arrived at after this opinion had been formed, "That the catalogue include both an author's and a subject index, according to the schemes of the Provisional International Committee," must, in fact, be read as a resolution to establish the catalogue.

Of the countries represented at the various Conferences, excepting Belgium, not one has expressed any unwillingness eventually to co-operate in the work. Unfortunately, neither the United States nor Russia was officially represented on the present occasion. The attempts that have been made to induce the government in the United States to directly subsidize the catalogue have not been successful; but that the United States will contribute its fair share, both of material and pecuniary support, cannot be doubted. There, as here, private or corporate enterprise must undertake much that is done under government auspices in Europe. As to Russia, the organization of scientific workers there has been so little developed that it is very difficult to secure their attention, and probably our Russian colleagues are as yet but very imperfectly aware of what is proposed. The importance of Russian scientific work is so great, however, that it stands to reason that it must be fully considered; and it may be supposed that Russia will join when she becomes acquainted with what is proposed and what is required of her.

A Provisional International Committee has been appointed, which will take the steps now necessary to secure the adhesion and co-operation of countries not yet pledged to support the scheme.

Originally, it was proposed to issue a card as well as a book catalogue, but on account of the great additional expense this would involve, and as the Americans in particular have not expressed themselves in favor of a card issue, it is resolved to publish the catalogue, for the present, only in the form of annual volumes.

From the outset great stress has been laid on the preparation of subject indexes which go behind the titles of papers and give fairly full information as to the nature of their contents. At both the first and the second International Conferences this view met with the fullest approval. Meanwhile, the action of the German government has made it necessary to somewhat modify the original plan. In Germany, a regional bureau will be established, supported by a government subvention, and it is intended that the whole of the German scientific literature shall be catalogued in this office; no assistance will be asked from authors or editors or corporate bodies. In such an office it will for the present be impossible to go behind titles; consequently, only the titles of German papers will be quoted in the catalogue. In the first instance, some other countries may prefer to adopt this course on the ground of economy. But in this country, at least, the attempt will be made to deal fully with the literature, and the co-operation of authors and editors will be specially invited. An author may not always be best able to judge which are the most important points in his paper to be noted in an index, but the experience gained in the Royal Society during several years past has shown that authors furnish most valuable information, and that their suggestions are easily reduced into shape. A full code of instructions for the use of the regional bureaus is now being prepared under the auspices of the Provisional International Committee.

The catalogue is to be published annually in seventeen distinct volumes. The collection of material is to commence from January 1, 1901. As it will be impossible to print and issue so many volumes at once, it is proposed to publish them in sets of four or five at quarterly intervals. During the first year, parts covering shorter periods will be prepared, so as to make the subsequent regular issue possible of volumes in which the literature published during a previous period of twelve months is catalogued. Valuable opportunity will thus be given from the outset of gaining experience both in the preparation and use of the catalogue.

That many difficulties will be encountered in carrying out the work cannot be doubted; but if scientific workers generally will but reflect on the inestimable value of accurate classified subject indexes, they cannot but see that it will be to their great advantage to do all in their power to further the enterprise. If the attempt fail, it will only be because those on whose behalf it is undertaken are blind to their own interests.

OUR TRADE WITH OUR ISLAND POSSESSIONS.

The imports into the United States from Cuba, Porto Rico, Hawaii, and the Philippine and Samoan Islands for the fiscal year just ended amount to over \$60,000,000. Over \$40,000,000 of this in sugar and molasses, \$10,000,000 tobacco, \$5,000,000 vegetable fibers, \$1,000,000 iron, copper and manganese, and the remainder such miscellaneous tropical products as coffee, cocoa, sponges, tropical fruits, vegetables, hides and skins, and cabinet woods.

The sugar importations from the islands form practically one-third of the total sugar brought into the United States during the year, amounting to about 1,400,000 pounds out of a grand total of over 4,000,000 pounds imported. Of the total sugar importations from the four islands, Cuba supplied slightly more than one-half, though in value the importations from Hawaii exceeded those from Cuba, Hawaiian sugar being of a higher grade and consequently representing a larger value, although the number of pounds was materially less than that shown by the import figures for Cuba. The total importations of sugar during the year from Cuba were 705,456,352 pounds, valued at \$18,343,659; those from Hawaii, 504,713,105 pounds, valued at \$20,392,150. Rorto Rico occupies the third place in quantity and value of sugar imported from the islands, the total for the year exceeding 80,000,000 pounds, while from the Philippines the total for the year is in round terms 50,000,000 pounds.

The second item of imports from the island, considering them in the order of magnitude, is tobacco, amounting in round terms to \$10,000,000 in value, which represents about two-thirds of the total importations of tobacco into the United States. The total value of manufactured and unmanufactured tobacco imported during the fiscal year is about \$16,000,000 and that from the four islands slightly above \$10,000,000. Of this the very large proportion comes from Cuba, the total value of tobacco imported from Porto Rico dur-

ing the year being about a quarter of a million dollars, from the Philippines but about $1,000 and from Hawaii less than $100.

The third item of imports from the islands, considering them in the order of magnitude, is manila hemp, which comes, as the name indicates, from the Philippine Islands, the total value of the importation of this article being for the year $7,172,368, of which $5,024,770 came direct from the Philippines.

THE EXHIBIT OF THE DUTCH EAST INDIES AT THE PARIS EXPOSITION.

OVER 2,500 square yards, near the Siberian pavilion, are devoted to the Dutch East Indian exhibition. It consists of three separate buildings; in the center stands the Temple of Pjandi Sari, which is one of the most remarkable specimens of Hindoo architecture in the Island of Java. It is supported on either side by two models of native houses. The temple is an imposing structure and its decoration is magnificent. The exact replica has been conscientiously and artistically achieved by the aid of moldings cast from the actual sculptures in the temple in Java. The temple is built in two terraces, one above the other. The base of the second terrace is covered with reproductions of remarkable bas reliefs from a temple which represent scenes in the life of Buddha. They are 200 feet long. Inside of the temple are grouped reproductions of the most beautiful specimens of Hindoo architecture and sculpture, as shown in our engraving, for which we are indebted to L'Illustration.

INTERIOR OF THE PAVILION OF THE DUTCH EAST INDIES AT THE PARIS EXPOSITION—EXHIBITION OF IDOLS.

EGYPTIAN TEMPLES.

By ALEXANDER PAYNE, F.R.I.B.A.

A MEETING of the Architectural Association took place recently, at which Mr. Payne then read his paper on "Egyptian Temples," of which the following is a summary:

I think I may say without fear of contradiction that in studying the temples of Egypt we are studying the earliest monuments that exist devoted to religion and erected by what was the most civilized nation of the ancient world.

There is evidence to show that most of the religions of the ancient world were derived from a common origin, and had for their main idea either the worship of the powers of nature or as regarding nature as a theater descriptive of divine things. In Egypt it is certain from the monuments themselves and the representations on them that their early worship was derived from the phenomena of nature, and fortunately we have from Egyptian hieroglyphics a full description of what took place in each room of the temples, where staircases are provided leading up to the flat roofs, so that certain ceremonies might take place in full view of the heavenly bodies in honor of which the services are held.

When the Greeks and Romans successively conquered Egypt and made it a province of their empires no attempt was made to disturb their worship and religion, so similar in some respects to their own; in fact, the Egyptian deities were at once adopted as part of the State religion, and vast sums were spent in the restoration of the ancient temples, evidently under the direction of the Egyptian priesthood, and, judging from the inscriptions, with the most scrupulous conservatism of the ancient plan and purpose.

MEMPHIS.

Abydos has been called the cradle of Egypt, but the seat of the first settled monarchy appears to have been the great city of Memphis, just south of modern Cairo, and said to have been founded by Menes, the first historic king, about 4000 B.C. This city must have been one of the largest of the ancient world, and the ruins of an immense place remained as late as the twelfth century A.D.; but, owing to the inundations of the Nile, nothing remains of it at the present day but a few earth mounds and two colossal statues, which stood in front of the great Temple of Ptah, and the Pyramids and innumerable tombs built on the uplands west of the Nile, which formed the great cemetery of the city, and among which the famed Pyramids of Gizeh formed the chief. These are surrounded by whole streets of tombs.

The inundations of the Nile have also destroyed almost every vestige of the large cities which once existed in the Delta, so that it is necessary to go 200 or 300 miles up the Nile before reaching extensive remains of temples. The whole valley of the Nile, including the river itself, would appear to have risen since the times of ancient Egypt, so that the Temples of Denderah and Edfu, which will be described in detail, are now some 30 feet or 40 feet below the level of the ground, and have had to be dug out quite recently for their complete examination, and are now under the care of the Government as ancient monuments. There are also extensive remains at Kom Ombos, Esneh, Philæ, and other places on the river. It is at ancient Thebes that an idea of the magnificence of ancient Egypt can be best obtained. The ruins of temples and buildings there exceed those left in the remainder of Egypt altogether, if we except the Pyramids, and are far more extensive than anything remaining either at Rome or Athens. The site of the ancient city, being mostly above the level of the inundation, has escaped the destruction that has fallen upon other cities. Thebes dates from a high antiquity, and a few of the more ancient parts of its temples are from the time of the Eleventh Dynasty, about 2500 B.C.; but under the Pharaohs of the Nineteeth Dynasty (about 1400 B.C.), Seti I. and Rameses II., etc., the chief seat of government was transferred from Memphis to Thebes, and the city was embellished with the magnificent temples of which the ruins now remain. The great group of Karnac alone is nearly a mile long and one-third of a mile wide, and comprises a whole assemblage of temples connected together by avenues of sphinxes. These buildings are mostly far too complicated and elaborate to describe in the limits of a single paper. Moreover, they show in many instances a departure from the original and simple plan of the early temples dedicated to the gods; the monarchs of this period would seem to have been almost intoxicated by the grandeur of the Empire and the extent of its foreign conquests, and the temples are covered with inscriptions of their own glorious doings, and, though the credit of them is all ascribed to the gods, the prevailing sentiment seems their own glorification.

EGYPTIAN COSMOGONY.

The Egyptians imagined the world to be a vast plain suspended in space, of which Egypt, with the Nile running through it, was the center and by far the most important part, the nations round being comparatively barbarous and uncultivated. Below this plain was stretched out the plain of the nether world, with another Egypt and Nile almost the counterpart of those in this world; the sun and moon and heavenly bodies, after traversing above the world, descended in the west and passed back again over the plain of the nether world, rising again in the east. All the spirits of the departed went to the nether world, and those that were judged worthy of continuing life remained there with the same avocations and amusements that had occupied them in this world.

It is at Denderah before we come to any considerable remains of a temple. This temple, as it actually stands, was rebuilt in the time of the Ptolemies, and the decorations were continued down to the time of the Roman emperors, but the inscriptions show that it was a restoration of an older temple which stood at the same place from the very earliest times. One inscription says: "The great building plan of Ant (Denderah) was found written in ancient characters on hide of the times of the successors of Horus." Another inscription says that King Totmes III. made a restoration of this monument found described in ancient characters of the time of King Khufu (the builder of the Great Pyramid of Gizeh). Thus it appears that the Egyptians regarded themselves as the keepers of the sacred plans of the religious buildings, which were handed down by writing and tradition from the most ancient times, and were not deviated from in any essential particular; we may, therefore, regard them as models of the ancient temples which existed from the earliest times, and it is interesting to notice many features in common between them and the Tabernacle erected by Moses by divine command and the temples of Ezekiel and Herod, and also the temples of the Greeks and Romans; there is as much similarity in the plan and arrangement of the great temples of Egypt as there is between the different cathedrals of the Christian Church. This temple of Denderah was dedicated to Hathor.

EGYPTIAN MYTHOLOGY.

Egyptain mythology is complicated by the fact that in various localities different names are applied to the same idea. The fundamental principle seems to have been to regard the heavenly bodies and powers of nature as symbols of the attributes of the Deity, and in most localities there is a divine Trinity. First, there is the masculine or creative principle symbolized by the sun, and called Ra-Harmachis at Heliopolis, Amen-Ra at Thebes, and so on; and in the philosophical idea representing the powers of goodness and light as opposed to evil and darkness. Secondly, there is the feminine or receptive and maternal principle symbolized by the moon and stars, and called Isis, Hathor, Muth, and several other names; and in the philosophical idea representing truth and faith, which keep alive and preserve the powers of goodness in states of decline symbolized by the night. Finally, as the result of a marriage or union between these two, there follows the third principle, the new-born day,

represented by the sun rising again and called Horus; and in the philosophical idea representing the resurrection, and regeneration, and the dawn of a new era of religion and civilization in the world. The ceremonies and processions which took place in the temples would appear to have been theatrical representations of what takes place in nature; each hour and day being symbolized as a separate deity, and the great event being the triumph of the sun over the powers of darkness and its bursting forth in renewed splendor at the opening of day.

There was probably an entrance court before the Temple of Hathor at Denderah, but if so it has been destroyed, and now one enters directly into a hall or porch supported by twenty-four columns; this is the Hypostyle Hall or Khent Hall—that is, Front Room. It is 143 feet broad, 80 feet deep, and about 50 feet high; it is a most noble apartment of harmonious proportions, and at once strikes the beholder with its grandeur; the walls are decorated with reliefs recording the various Pharaohs who built or restored the temple.

The ceiling represents the firmament and stars.

Passing through this room, with its beautiful and massive columns covered with inscriptions, we proceed along the central axis of the temple into the Hall of the Appearance, so called because the statue of Hathor, "the golden-rayed," was brought on festive occasions from the Holy of Holies in the rear into this hall to be exhibited to the people, who did not advance beyond the Front Room; this room is 45 feet 6 inches square, and the ceiling is supported by six columns.

There were three small rooms on each side of the Hall of Appearance; one of those on the left side was the temple laboratory, where the incense, oils and ointments were prepared for the temple services, as the inscriptions thereon show. The second room is called the Assembly Room, and it is supposed the offerings were placed here on the festal days. The third room afforded a passage out of the temple. One room on the right, or west side, was called the Silver Room, and contained the jewels and ornaments of the divine image and temple utensils of costly materials, as shown in the inscription, which gives the uses of the room. The second room formed an exit from the temple on that side; the third room formed a sort of ante-room to the stair leading to the roof on that side.

Following the main axis of the temple, the next room is called the Hall of the Altar, immediately behind the Hall of the Appearance. On the left from this a small ante-room leads to a long straight staircase ascending to the roof. There is also a room on this side called the Room of Purification, probably used in the preparation of festival ceremonies. On the other side is another staircase, of short flights, winding round a square with landings at the angles and ascending to the roof; the inscriptions on these rooms and staircases refer to the great New Year's Festival, on which occasion there was a solemn procession of the priests carrying images of the deity through the temple and afterward to the roof. On the roof is a small temple, from which the rising sun or the moon and the stars could be seen, and which presumably formed the goal of the procession before proceeding down the other staircase. The next room in the center of the temple axis behind the Hall of the Altar is called the "Hall of the Cycle of the Gods," or the "Middle Hall," and this is immediately in front of the cellar, adytum, or Holy of Holies. This sanctuary is surrounded by a passage round which are a series of small rooms used in the services of the temple.

Next to the dwelling of Hathor is "the Chamber of Flames," where the goddess is represented exterminating evil with fire; the next is called the "Throne Room of Ra"—the Sun—where the Pharaoh (who represented the deity on earth) is shown destroying a crocodile (evil) with his lance. On the west side are the "Room of Purification" and "the Room of a Necklace," where the king is shown presenting a necklace to Hathor. In the thickness of the walls of the temple are twelve crypts or secret chambers, in which, it is supposed, the treasures were kept, and the entrances to which were ingeniously concealed. On the roof were six rooms, three on the east and three on the west side, devoted to the worship of the slain and risen Osiris, as shown by the inscriptions.

I have passed by Abydos, where there are interesting mortuary buildings with some of the most beautiful sculptures of Egypt, dating from the time of Seti I.; and shortly above Denderah we come to Thebes, with the great temples of Karnac and Luxor. It is quite impossible in the limits of one evening to describe these in detail.

Almost all the temples on the west bank of the river were mortuary buildings, the west or setting sun being devoted to the dead.

ESNEH.

We next make a stop at Esneh, 484 miles above Cairo, where are the remains of the Hypostyle, or Front Room, corresponding with the similar apartment already described for Denderah; it is a very noble specimen, in excellent preservation. The size of the hall is 103 feet by 52½ feet, and is supported by twenty-four columns 37 feet high. There are high abaci over the capitals of the columns, on which rests the massive architraves, and again on these the roofing blocks, each varying block from 22 feet to 26 feet long and 6 feet 6 inches wide. It is calculated that there are 110,000 cubic feet of sandstone in this hall alone, and the whole of the interior is covered with inscriptions. According to these, the hall was founded not later than Totmes (Eighteenth Dynasty) and afterward rebuilt by the Ptolemies; it was dedicated to the ram-headed Khum-Ra, one of the representatives of the sun god, and signifying the union between the rising and setting sun.

The hall is remarkable for the great beauty of the capitals of its columns, which differ from one another, but are not discordant. The sculptor has derived his inspiration from the lotus, palm, and other foliage.

EDFU.

A few miles above Esneh is Edfu, a little village in which stands the most complete specimen extant of an ancient Egyptian temple. The plan is almost the same as that at Denderah, with the addition of a large court surrounded by a colonnade in front of the temple, entered by a huge pylon or gateway, with two pyramidically-shaped massive towers, which originally formed the main entrance to all Egyptian temples. There is also a girdle or encircling wall going round the whole temple and forming an outer protection, which probably originally existed round most Egyptian temples. The pylons in front, or "watch towers," as they are called in the inscriptions, are 100 feet high; an easy staircase surrounded with good hewn stone in large blocks in the pylon ascends to the summit, from which a magnificent view of the winding Nile is obtained. In front of the pylons are four vertical deep niches, in which were placed the higher flagstaffs, covered with copper, as the inscriptions tell us, "to avert the storms of heaven"; in other words, they acted as lightning conductors as well as flagstaffs, a proof of the scientific attainments of the Egyptians.

The open court in front of this temple (which is wanting in Denderah) is spacious and open to the sky, paved with flags and surrounded by thirty-two columns on the south or front, the east and west sides forming a colonnade. The temple itself is sacred to Horus (the sun at his rising). The orientation is exactly the opposite to that at the Temple of Denderah, the front of which faces north, whereas this temple faces south; that is, it faces the position of the sun during the daytime, whereas the one at Denderah, dedicated to the gods and goddesses of night, faces the position of the sun in the nether world, according to Egyptian ideas, during the night. The temple was rebuilt during the reigns of the Ptolemies, but the inscriptions inform us that it was carried out according to the plan of the great writing that fell from heaven to the north of Memphis. It is further stated that the Great Hall was built according to the arrangements of temples written by Kherheb Imhotep, son of the god Ptah; this shows that the Egyptians, in the arrangement of their temples, rigidly adhered to the traditions handed down to them from antiquity and preserved among them in writing. As at Denderah, a history of this particular temple and a description of the rooms and the uses to which they were put is given in inscriptions on the walls. From the foundation of the new temple to its completion and the festal entry of the Deity (B. C. 142) was a period of ninety-five years. The hall following the front room at Denderah (a temple sacred to the gods of the night) is called the "Hall of the Appearance," and the next room the "Hall of the Altar"; then comes the "Hall of the Cycle of the Gods." I suggest that this is because after the sun has run his course, at night he appears in the hall to the worshippers in all his glory, Hathor being on such occasions called the Golden Beamed and the Sun Goddess, and all the powers of heaven are, as it were, awake to their duties; but the corresponding rooms at the Temple of Horus (a god of day), at Edfu are called the "Festal Hall" and the "Hall of the Repose of the Gods," which seem to indicate the refreshment and repose of the deities after the day's work is done.

Following the front court, we come upon the Hypostyle Hall, or front room, which forms the first room at Denderah as it now stands. This hall contains, against the front wall and between the pillars, two little rooms, one on each side like chapels, which we learn from the inscriptions were intended, the one on the left as an incense chamber to hold the incense and holy water required on religious festivals, and the one on the right as a chamber or safe for the sacred rolls and books of the temple, a catalogue being given on the walls. The ceiling of this hall is covered with astronomical representations.

A few miles above Edfu the channel of the Nile contracts and passes through a chain of sandstone mountains, which are extensively quarried. Vast chasms are cut down through the mountains in every direction as if they had been sawn, the tool marks of some such instrument as a saw being plainly visible. These were the quarries of ancient Thebes, and extend for miles.

Forty miles above Edfu is the beautiful Temple of Kôm Ombo. The peculiarity of the plan is that it is a double temple, with twin entrances side by side, and double twin suites of rooms throughout; the left half on entry is sacred to Horus, god of the day, and the right half to Sebek, the crocodile-headed god (a god of the night). Like the other temples we have been examining, there has been a restoration under the Ptolemies of an ancient building which stood on the site.

A short distance farther south brought us to the first cataract, the southern end of Egypt proper, near which are extensive granite quarries. It is said that all the obelisks, granite blocks, and pillars found in Egypt came from these quarries; the labor of working them, and taking them down to the river and to their various destinations, must have been almost incredible.

Above the cataract and quarries is the picturesque island of Philæ, crowned with temples, walls, and colonnades. The island is about a quarter of a mile long, and 150 yards broad; the Temple of Isis, with its accessories, occupies about half the length of the island. The temple was built at various times, and owes its charm not only to the gracefulness of its architecture, but also to the beauty of its situation. The inner part of the temple, the first apartment of which is an elegant hypostyle consisting of an uncovered forecourt and a covered hall beyond, with four columns on each side, is one of the most beautiful halls in Egypt, not only on account of its well-balanced proportions and admirable preservation, but especially on account of the beautiful and delicate coloring, which, being very little perished, conveys a better idea than almost any other example of what the gorgeous effect of these buildings must have been when their colors were fresh and unfaded.

On the east side of the island is an elegant little temple, or pavilion, which goes by the name of "Pharaoh's bed," with five columns on each side and four at each end, and half enclosed; it is a favorite subject with painters on account of its elegant form and suitability to the landscape, though the inscriptions within it are of no importance.—Building Journal.

Guatemalan Cattle Exports.—Under date of June 16, 1900, Minister Hunter sends from Guatemala copy of an executive decree of the 9th instant, increasing the tax upon each head of bovine cattle exported from the Republic to $70.

SELECTED FORMULÆ.

Indelible Ink.—So-called indelible ink for marking cotton or linen is usually made from a salt of silver, the mark in this case being black. The nitrate is taken as a base and alkalies are added. A mixture of this kind, in which sodium hydrate (caustic soda) was used, exploded with great violence, and explosions are reported of other similar inks, the precise formulas of which we do not know. This accident has fortunately been rare, and unfortunately lacks convincing explanation, so that it is not clear as to what precautions or modifications are necessary.

In view of the difficulty it would be as well to try the following:

WOODHOUSE'S INDELIBLE INK.

Nitrate of silver	1 ounce.
Infusion of nutgalls	2 drachms.
Gum arabic	2 "
Water	8 ounces.

Dissolve the nitrate of silver in 4 ounces of water. In the remainder of the water dissolve the acacia and add the infusion. Then mix the two liquids.

The infusion of nutgalls is made by pouring 1 ounce of boiling water upon 30 grains of powdered nutgalls.

A more modern and presumably cheaper indelible ink is made by the following formula, which is not so convenient, however, in use, as will be seen by the directions:

INDELIBLE INK WITHOUT SILVER.

A.

Anilin hydrochlorate	20 parts.
Mucilage of gum arabic	25 "
Glycerin	15 "
Water	100 "

B.

Copper chloride	3 "
Sodium chlorate	3 "
Ammonium chloride	2 "
Water	40 "

Mix equal parts of the two solutions just before wanted for use.

By pressing the writing with a hot iron the development of a black color is hastened.

RED INDELIBLE INK.

It is said that by proceeding according to the following formula, an intense purple-red color may be produced on fabrics, which is indelible in the customary sense of the word:

I.

Sodium carbonate	3 drachms.
Gum arabic	3 "
Water	12 "

II.

Platinic chloride	1 drachm.
Distilled water	2 ounces.

III.

Stannous chloride	1 drachm.
Distilled water	4 drachms.

Moisten the place to be written upon with No. 1 and rub a warm iron over it until dry; then write with No. 2, and, when dry, moisten with No. 3. An intense and beautiful purple-red color is produced in this way.

A very rich purple color—the purple of Cassius—may be produced by substituting a solution of gold chloride for the platinic chloride in the above formula.—Druggists' Circular.

A Simple Beetle Trap.—Mons. Desiré Maes gives the following simple method of making a beetle-trap: Into a china wash-hand basin, half filled with water, pour a glass of beer; cover the basin with a newspaper, in the center of which a small round hole is cut. Place it so that the edges of the paper lie on the floor and the hole is over the center of the basin. At night the beetles, attracted by the smell of beer, climb the paper and fall through the hole into the liquid.

Remedy for the Carpet Beetle.—A suburban entomologist has discovered that formaldehyde is a sure destroyer of the carpet beetle, known as Buffalo bug. This insect is, in this locality, rapidly giving the moth points in destructiveness. It eats any textile fabric, silk, linen or wool, and has defied all known methods of annihilation. Method: Close your apartment or closet, and generate your gas from either methyl alcohol or solution of formaldehyde.—Popular Science.

Russet Shoe Polish.—

THE LIQUID.

Beeswax, yellow	2 ounces.
Linseed oil	3 "
Oil turpentine	10 "
Dissolve by heat of a water bath and add	
Soap shavings, hard yellow	1¼ "
Dissolve in	
Hot water	14 "

THE PASTE.

Beeswax, yellow	1 ounce.
Palm oil	1 "
Oil turpentine	3 "

Melt on a water bath.

Yellow Dressing for Leather.—

Water	162·5 parts.
Borax	5 "
Aniline "leather brown," water soluble	1 "
Orange shellac	15 "
Ammonia water	1·25 "
Distilled water	1·25 "

Bring the water to a boil, add the borax and dissolve, and to the solution add, a small quantity at a time, the aniline color (which should be free from iron). When the water is boiling actively add the shellac, a little at a time, stirring vigorously while doing so. Let boil for ten or fifteen minutes, pour off into a clean vessel, and allow the mixture to cool down. Mix the ammonia and water, and when the mass is quite cool, stir the mixture well in. Other colors (water soluble) may be used instead of the leather brown, a little experimenting showing the amount to be employed.—Pharmaceutical Era.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Chemical Foods in Germany.—In opposition to the determined vegetarians who condemn all animal food, there is a growing number of physiologists who insist that abstention from meat, if continued for ages and generations, is responsible for the feebleness and low intellect of certain races. Chemists are becoming more and more anxious to find new sources of nitrogenous foods, and the artificial food industry has developed widely in Germany, chiefly in the large works which supply dye stuffs, for which albumen is an important material.

The artificial foods are mostly mixtures of more or less secret composition. Thus the tropon of Prof. Finkler, of Bonn, whose works are at Mühlheim, consists of one-third of animal and two-thirds of vegetable albumen. Albumenose is a frequent constituent of those foods. By albumenose is understood a preparation which, as regards solubility, occupies a position intermediate between the original animal albumen and its peptone.

The managers of the Elberfeld Farbenwerke have made a hit with their somatose, which is such an albumenose, and have quite recently brought out the more economical tannin and milk somatose, which may become a very important food for the masses. This latter preparation utilizes the casein of the milk.

The nutrose of the dye works at Höchst; the eukasin of Salkowsky; the sanatogen of Bauer & Co., of Berlin, contain all the casein compounds with sodium or ammonium.—Oliver J. D. Hughes, Consul at Coburg.

The Supply of Gutta-Percha.—Under date of May 19, 1900, Consul Hughes of Coburg, writes:

According to a work on the subject just published in Germany, the supply of gutta-percha is almost exhausted, owing to the reckless and primitive way in which the trees were treated in Sumatra and Borneo, whence the principal output has come. As these trees will flourish only in a very few places, the question has become serious. The book adds that the Philippines is the proper place to grow gutta-percha cheaply and profitably.

New German Process of Welding Pipes.—At a congress of the Saxon associations of engineers and architects just held at Leipzig, Mr. Max Schiemann, of Dresden, delivered a lecture, accompanied by experiments, on the "Goldschmidt process for obtaining high temperatures and its practical application." He compared this new process with those hitherto used for heating metals for welding. He showed by experiments the new method of welding cast iron gas pipes of 2 to 4 inches in diameter, and demonstrated the very simple application of the process and its result. Briefly stated, it consists in mixing powdered aluminium with oxide of iron and adding to it an easily ignitable substance. This powder is put into a clay crucible and then ignited by means of a match. The resulting chemical action renders the mixture liquid, and this liquid is then poured around the place to be welded. The object assumes a white heat, and the welding is done by a very simple apparatus. The welded places show the same firmness as the original piece, and manifold application of the method is possible. In the near future, it is proposed to weld the rails of the electric tramway at Dresden, which has already been done in other cities. The speaker welded rails before the audience, and the experiments were pronounced very successful, especially on account of the simplicity of the process. It is considered a very important discovery, and great hopes are entertained for it.—Richard Guenther, Consul-General at Frankfort, May 28, 1900.

Musical Instruments in the Philippines.—Consul Winter sends the following from Annaberg, June 12:

The French consul in Manila calls attention, in a report, to the favorable opportunity for selling musical instruments in the Philippines. He says there are few of the natives who do not play some sort of an instrument, such as a mandolin, guitar, violin, or flute. The musical talent of the people is great. Thus far, the business has been done principally by Americans. The Consul thinks German manufacturers, if they would study the conditions of the market, could secure much of the trade. Only the cheapest sort of instruments can be sold, for the Tagal, as a rule, is not able to pay high prices. Instruments which have a showy exterior are preferred.

New German Glass.—Under date of May 29, 1900, Consul Hughes writes from Coburg:

In the Saxon Art Club at Dresden there are on exhibition at present two large glass pictures exemplifying a new kind of material called "Theophilus glass," which the manufacturer thinks unites the advantages of American opalescent glass with the capacity of being able to stand the burning-in process. The firm of Putzler Brothers, in Penzig, has been manufacturing for some time this glass, as made by A. Freystadtl. The way in which it is made, it is claimed, is quite different from that of the American opalescent glass. It receives its color in a pot and is then blown in large cylinders—a process quite similar to the manufacture of window panes. The windows manufactured by Freystadtl show on large unpainted places (which would appear empty and hard if ordinary glass had been used) a mild luster and a soft play of color. Freystadtl has received a large order for supplying the newly built house of the St. John's Guild, at Riga, with figures, coats of arms, and ornaments in this material. Looking at this new discovery from an impartial point of view, the Theophilus glass is wanting in that beautiful luster and finish of our world-known Tiffany glass, many poor and inartistic imitations of which are being put by Germans on the markets of the world.

Flour in Japan.—In reply to inquiries from an Ohio firm (which has received a copy of this report), Vice-Consul-General McLean writes from Yokohama, May 1, 1900:

The importation of wheat flour from the United States is increasing, and the greater portion of such importation comes from California, Oregon, and Washington. There are four grades imported, and the largest quantities consumed are of the two lower grades. The consumption is not confined to the large cities, the use of flour becoming common throughout the country.

The importers of flour are principally foreign concerns, although one or two native houses have imported some from time to time during the past two years. Importers confine themselves entirely to certain brands which have made a reputation in this market.

Complaints and rejections occur in this business as in others. So far as I know, importers meet their drafts. The business is usually done under banker's letter of credit.

The flour generally arrives in a very good condition; if a small amount of damage occurs, it is as a rule paid by the ship's agents. If the vessel has had unusually rough and bad weather, a protest is made and the claim is paid by the insurance companies issuing the policies on the goods.

There are three or four American-built flour mills now in operation in Japan, the largest having a capacity of 150 barrels a day.

There are a great many small native mills of hand and water power throughout the country. The production of the latter is of a coarse character and does not compete to any extent with imported stocks. It is used principally by the farmers in the immediate neighborhood.

American wheat is being imported largely, one firm alone having imported 2,000 tons in the last six months. Indian wheat is entered to a certain extent.

I cannot say definitely if flour made in Japan from American wheat is cheaper than that imported, but I know that a considerable quantity of it is sold.

Merchants here are of the opinion that the flour business with Japan is overdone. Many of the importers are holding very heavy stocks, and the margin of profit amounts to only a small commission. But the demand is increasing rapidly throughout the Orient, the best points of consumption at present being Russian possessions in Northern China and Eastern Siberia.

American Clover Seed.—Consul Schumann, of Mainz, informs the Department that a newspaper of that city warns the farmers against buying American clover seed, giving as reasons that it contains so many weed seeds as to utterly ruin the fields planted therewith, besides yielding only a very poor crop. A copy of the above was sent to the United States Department of Agriculture and elicited the following reply from Mr. Andrew Geddes, chief clerk:

The charge that American clover seed is impure is very rarely made by European dealers or experiment-station workers of repute. On the contrary, the fact that American clover seed is very pure and of excellent germinating quality has been recognized even by those who oppose its use by European farmers. Among the seed-control workers in Europe, Nobbe, Eidam, and Kirchner have given testimony to the high purity of American clover seed, although the latter two have been hostile to the American seed.

Very little European clover seed finds its way to America, and it is thus impossible to make a definite statement of its purity as the result of our own investigations. However, the Department of Agriculture secured this spring twenty samples of European clover seed for experimental purposes. The average purity of these was 93·49 per cent. The average purity of one hundred and fifty samples of American clover seed of all grades sold on the American market during the past winter was 95·5 per cent.

The charge that the product from the American seed is inferior to that from the European seed is a more serious one, inasmuch as it is made by the greater number of workers in the seed control stations. There are, however, notable exceptions. Dr. Nobbe, of Tharand, has always maintained that the American clover was of good quality; and in a recent issue of The Deutsche Landwirtschaftliche Presse, Dr. Kirchner, who had previously maintained that American clover was inferior, gives the results of tests that clearly show the American product to be better than the European. The explanation of these conflicting reports is doubtless that the American seeds used in these tests did not all come from the same part of the United States and were of varying quality.

Experiments are now being carried on under the direction of the Secretary of Agriculture to determine the relative value in the United States of clover seed of European and of American origin, and these will probably be followed by extensive tests to determine the value of seeds produced in different sections of the United States.

The Lapidary Industry of Birkenfeld.—The cutting and polishing of precious and half-precious stones forms the chief industry of the little principality of Birkenfeld, up among the hills of the Nahe River, and gives employment to over 5,000 persons.

Although an improved factory system is gradually superseding the laborious methods of former times, there are nevertheless plenty of the old polishing and cutting works, which bear evidence to the lives sacrificed to this industry.

In the early days of the trade, agate quarries existed in the near-by hills, and this half-precious stone was cut and polished by a very laborious method, which is still practiced, although the agate quarries have long been exhausted and the raw material—as well as amethyst, jasper, opal, topaz, etc.—has been imported (since about 1834), chiefly from Brazil, whence it is shipped to this out-of-the-way place to be cut, shaped, and polished for the jewelry trade.

The usual method employed in cutting and polishing these stones is the following:

In a rude hut by a stream, which furnishes the power, four large grindstones about 4 feet in diameter are so fixed that their axes are only about 1 foot above the floor, into which a slit is cut, so that part of the grindstone is below its level. This lower portion passes through the water, thus keeping the stones constantly wet.

The operator has a bench or block of wood about 18 inches high, hollowed out to receive his chest and body. On this bench he lies at full length, and with his fingers holds the small piece of opal, amethyst, or other stone which is to be cut, against the grindstone, slightly above the level of the floor. In this position the men lie from morning to night, day after day. Consumption usually carries them off at an early age, but other men are found to follow this vocation, as the earnings are comparatively high. The operator usually owns his grindstone, or at least half of one. This represents an investment of about $500, and a skillful lapidary can earn from $15 to $25 per week. He does not usually cut and polish stones on his own account, but generally contracts with manufacturing jewelers, who furnish him the stones in the rough, to cut and polish at a certain price per gramme. As the stones, even in the rough, represent quite an outlay of money, the honesty of the workman must be greatly relied upon, for nobody can say in advance how many grammes of finished stones a certain piece of opal, amethyst, or the like may yield.

Besides these half-precious stones, precious stones such as diamonds, etc., are also cut and polished there; but this is an entirely different branch of the industry and is chiefly carried on in factories with modern machinery.

Another branch of the industry in these parts is the cutting of cameos.

Pearls are also polished, drilled, and cut and shipped in large quantities to all countries, including the United States, invoices covering single shipments of the value of $60,000 having been certified to at this consulate.

It is strange that this industry still flourishes in the little villages of this principality—removed from railroad communication and far away from the sources of supply of the raw material.—Walter Schumann, Consul at Mayence.

Foreign Shares in Japanese Railway.—Minister Buck writes from Tokyo, June 9, 1900, that the Minister of Communications has sanctioned the ownership of shares in Japanese railway companies by foreigners. This action was the result of inquiry from several railroad companies in the country stating that as the law did not forbid it, it was thought that foreigners had the right of ownership in their shares, and asking instructions. One railroad company has applied for permission to change the articles of incorporation limiting the ownership of shares to Japanese subjects, which has been granted, and it is understood that other companies, as well as the one referred to, are to change their prohibitory articles in respect to ownership of shares by foreigners. The above, says Mr. Buck, may interest business men in the United States who may be inclined to invest in railroads in Japan.

Tanning Machinery in Spain.—Señor Casimiro Velasco, manager of a large establishment at Gijon, Spain, is convinced that the tanning industry of that country, in order to maintain its existence and prosperity in competition with France, Germany, and Italy, must be reorganized and equipped with the American machinery and improved methods which have revolutionized the European tanning industry during the past few years. Señor Velasco has at command a capital of 2,000,000 to 3,000,000 francs, which can be further increased if necessary, and is anxious to open relations with American manufacturers of tanning machinery and with experts who would be inclined to engage, either as employes or shareholders, in such an enterprise. He may be consulted by correspondence in English at the above address.—Frank H. Mason, Consul-General at Berlin.

The following details have been received from Vice and Acting Consul Monaghan, of Chemnitz, under date of June 16, 1900:

The direct road from the Elbe to the Baltic Sea offers a great saving both in time and money. Everything has been calculated for a large increase of trade. This can be seen from the fact that now the towing will be done by three tugs; later, by electrical appliances. The passage requires from eighteen to twenty-one hours. The finishing of this canal should make great changes in the commercial relations between the lands bordering on the Baltic Sea. Wares which up to this time could not be shipped, on account of the charges for freight on the railroads, can now be brought in.

Dutch Demand for Coal.—Consul Harris, of Mannheim, under date of May 19, 1900, says:

I have to advise the Department that I am receiving frequent requests from local coal dealers and manufacturers for prices of American coal on board ship at Rotterdam. These inquiries are from responsible parties and relate both to anthracite and bituminous coal. The people in this consular district are watching with intense interest the introduction of American coal. All prices for this market should be quoted f. o. b. Rotterdam. I have promised to ascertain approximate prices for parties here, and shall be greatly obliged for information touching the matter, with names of shippers from most available point for this market.

Belgian Demand for Coal.—Consul Brundage writes from Aix la Chapelle, May 30, 1900:

I have had an interview with a gentleman by the name of Henri Coopman, coal dealer of Verviers, Belgium, who purchases annually 200,000 tons of coal and bought to-day at mines in this district 10,000 tons at 160 marks ($38.08) per car of 10 tons f. o. b. cars at mines. He expressed an urgent desire to be informed of prices and ability to deliver American coal at Antwerp, Belgium. Agents of bituminous coal, semi-bituminous, and semi-anthracite seeking foreign markets should at once correspond with him, quoting prices and analyses.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

LEGISLATION FOR THE PROTECTION OF BIRDS OTHER THAN GAME BIRDS.

BIRD protection in its broadest sense appeals to many persons of diverse interests, and its importance is becoming more generally appreciated. The sportsman has long realized the need of protective measures, but the farmer has only recently learned to appreciate the full value of birds as insect destroyers. A more exact knowledge of their food habits has resulted in a higher estimate of their utility on farms and demonstrated more clearly than ever the necessity of active measures to insure full protection. Recent years have also witnessed a greatly increased interest in birds from an artistic standpoint, which has resulted in the formation of numerous protective organizations known as Audubon Societies. Still, bird destruction is going on rapidly in the United States, and in many regions there is a marked decrease in the abundance of certain species. Cheap guns, lax laws, the mania for collecting and shooting, and more especially the enormous demands for birds for the market and millinery trade are responsible for this reduction in bird life.

The protection of birds is a national, not a local question; it deals largely with migratory species which breed in one section, winter in another and traverse several States in passing to and from their breeding grounds. Legislation on this subject belongs primarily to the States, but in order to accomplish its purpose in a country like the United States there must be greater harmony of action between the several States. Absolute uniformity in the protective laws of fifty distinct commonwealths may be almost impossible of attainment, but it is highly necessary, and it seems to be feasible to secure a much greater degree of uniformity than at present exists. State laws may be supplemented to some extent by federal legislation and a bill has just been passed by Congress to regulate interstate commerce in game killed in violation of local laws. This is known as the Lacey act. It is the broadest and most comprehensive measure of its kind ever considered by Congress. It is intended to supplement existing State laws and in regulating interstate commerce in game, it will, doubtless, mark the beginning of a new era in bird protection. It contains three main provisions: First, it places the preservation of birds under the jurisdiction of the Department of Agriculture; second, it authorizes the Secretary of Agriculture to regulate the importation of foreign birds and animals and to prohibit the introduction of the mongoose, the flying fox, the English sparrow, the starling, or other species that may be injurious; prohibits interstate traffic in birds that promotes violation of interstate laws.

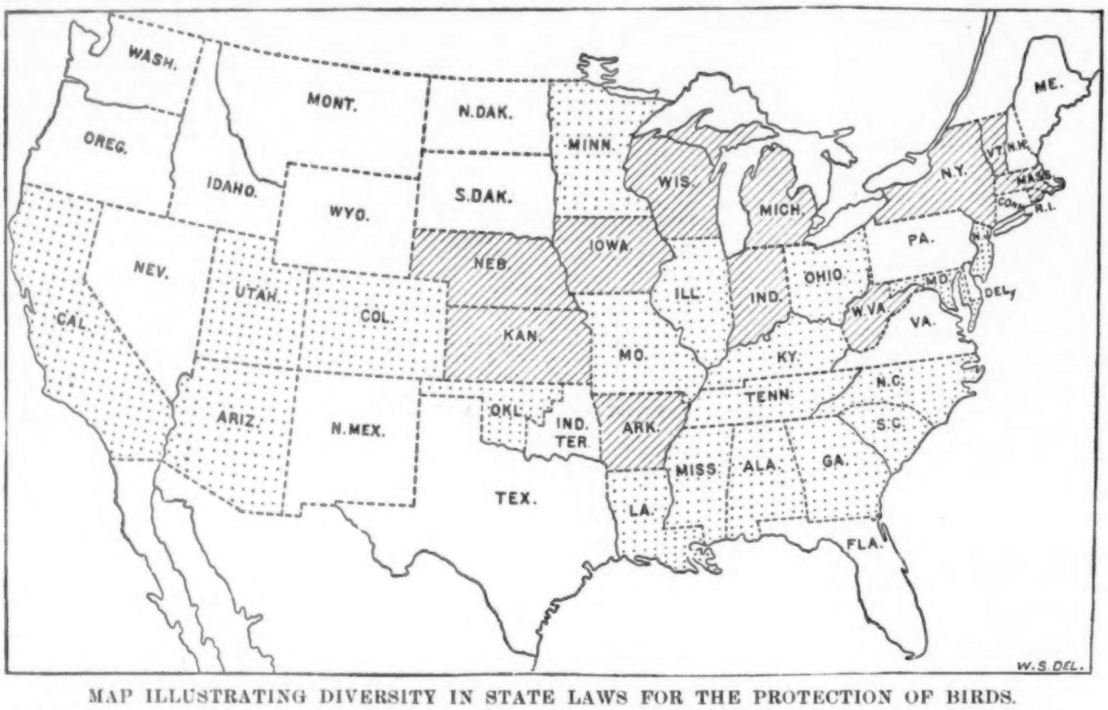
Similar, and perhaps greater, difficulties, exist abroad between the several countries of the Old World, including England, France, Germany, Austria, Italy, Belgium, and even Japan has taken steps to prevent the indiscriminate slaughter of useful birds.

An interesting pamphlet has just been issued by the Division of Biological Survey of the United States Department of Agriculture, entitled "Legislation for the Protection of Birds Other Than Game Birds," by T. S. Palmer, Assistant Chief of Biological Survey, and prepared under the direction of Dr. C. Hart Merriam, Chief of Biological Survey; and from this bulletin we have obtained our information, and also have reproduced from it some of the engravings. The pamphlet gives a history of protective legislation, a definition of game birds, and particulars of the species ordinarily considered game birds. Then follow sections on insectivorous and song birds, plume birds, birds of prey, and a list of the species protected in each State and in the Canadian provinces, together with a list of the species specifically exempted from protection. It also deals with permits for collecting birds and eggs for scientific purposes and with regulations regarding shooting birds in captivity, the influence of protective laws, necessity for other State legislation, federal legislation, etc. It is accompanied by a full digest of the measures for the protection of birds adopted by the various States up to the close of the year 1899, and also the laws enacted by New York and Rhode Island in 1900. This fairly represents the legislation in force in the United States at the close of the century.

From the standpoint of the sportsman, birds are either game birds or non-game birds, but from the legislative standpoint they may be roughly divided into three groups: First, species which should be protected at all times, as thrushes; second, species which may be killed at certain seasons for food or sport, as quail; third, species which are injurious and therefore should be excluded from protection, as English sparrows. The first group is usually called "insectivorous or song birds," the second "game," and the third "injurious birds"; but these groups are necessarily arbitrary and their limits are by no means certain. About 1,125 species and sub-species of birds inhabit North America north of Mexico, and of these only about 200, or 18 per cent., can truly be considered game birds. As the wording of modern protective laws turns largely on the definition of "game birds," it may be well to note some of the different interpretations which have been applied to the term. The Century Dictionary says: "A bird ordinarily pursued for sport or profit, or which is or may be the subject of a game law." In the different States the term is defined in various ways without special regard for uniformity. The plan of enumerating each species, as in some of these laws, is not clear or concise; it also lacks uniformity because of the confusion existing in the common names of certain game birds and the presence of species in one State which do not occur in another.

In order to overcome this difficulty, the Committee on Protection of Birds of the American Ornithologists' Union has suggested using the larger groups called orders and families, into which birds are commonly divided, instead of species, which give at once a simple and concise definition. "The following only shall be considered game birds: The Anatidæ, commonly known as swans, geese, brant, river and sea ducks; the Rallidæ, commonly known as rails, coots, mudhens, and gallinules; the Limicolæ, commonly known as shore birds, plovers, surf birds, snipe, woodcock, sandpipers, tatlers, and curlews; the Gallinæ, commonly known as wild turkeys, grouse, prairie chickens, pheasants, partridges, and quail." These four groups, the Anatidæ, Rallidæ, Limicolæ, and Gallinæ, include all the species which are commonly hunted for sport or for food in the United States, with the exception of cranes, wild pigeons, doves, flickers, meadowlarks, reed-birds, blackbirds, and robins. Cranes, pigeons, and doves are ordinarily considered legitimate game, but are now so rare in most States that it has become necessary to remove them from the game list. Flickers, meadow-larks, blackbirds, reed-birds, and robins, being insectivorous, are more valuable for other purposes than for food, and merit special attention.

Among species ordinarily considered game birds are wild pigeons and doves, which are represented in the United States by fifteen species and sub-species. Of these only three have any practical importance as game birds, viz., the messenger pigeon, now almost exterminated, the band-tailed pigeon, and the common mourning turtle or Carolina dove. The wild pigeon is now rarely seen, except in two or three States about the great lakes, where it is rigidly protected. Although



MAP ILLUSTRATING DIVERSITY IN STATE LAWS FOR THE PROTECTION OF BIRDS.

The Common Dove (Zenaidura macroura) is found throughout the United States. In 12 States (shaded) it is protected at all times, in 19 (dotted) only at certain seasons, while in the others it is without protection.

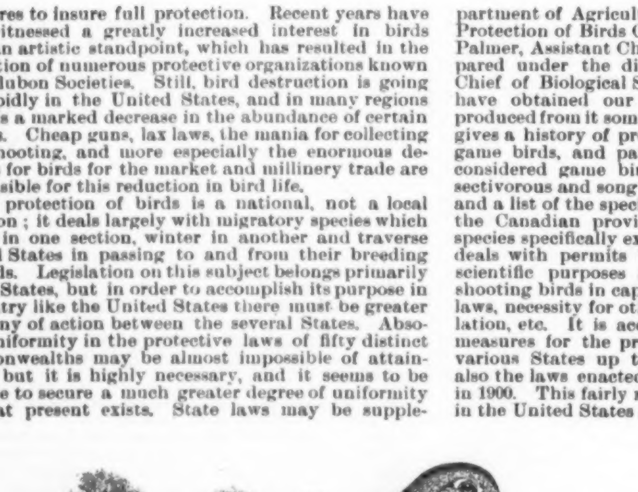


FIG. 1.—MOURNING DOVE (ZENAIDURA MACROURA).

FIG. 2.—FLICKER (COLAPTES AURATUS).

it was formerly one of the most important game birds of the country, the number of these birds has so diminished during the last thirty or forty years that it can no longer be considered as belonging to the game list. The band-tailed pigeon is an important game bird in only half a dozen States. The common dove, Fig. 1, is protected in some States throughout the year, in others only during the breeding season, while in still others it is not mentioned in the laws, and hence may be killed at any season. Our map illustrates the diversity in such lists for the protection of birds. In twelve States the common

Fig. 3.—BOBOLINK (DOLICHONYX ORYZIVORUS).

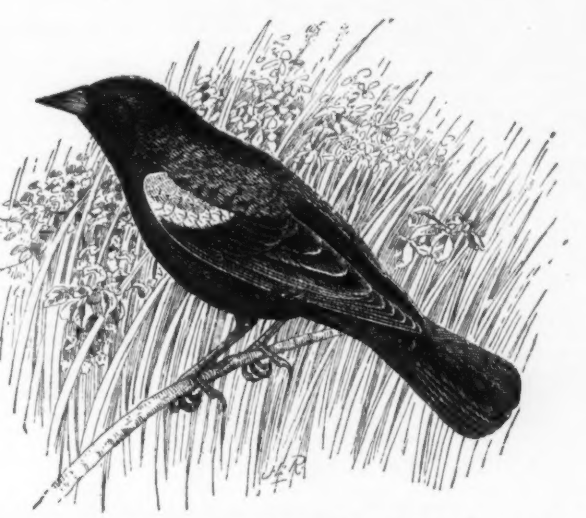


Fig. 5.—RED-WINGED BLACKBIRD (AGELAIUS PHŒNICEUS.)

dove is protected at all times, in nineteen only in certain seasons, while in the others it is without protection. Doves feed largely on seeds, and an examination of a considerable number of stomachs has shown that these include seeds of noxious weeds. Under some circumstances enormous quantities of weed seeds are devoured, as shown by the crop of a dove killed in a rye field in Tennessee, which contained no less than 7,500 seeds of oxalis stricta. As a weed destroyer the dove more than compensates for the grain which it occasionally consumes, and the value of its services is much greater than the few cents which its body brings in the market.

Of the woodpeckers the flickers, or pigeon woodpeckers, Fig. 2, represented in the East by the yellow-shafted flicker, and in the West by the red-shafted flicker, are they only ones which are killed to any extent for food. They are still regarded as legitimate game in some sections, but apparently are so treated by law only in Nevada. Like other woodpeckers, the flicker is mainly insectivorous. An examination of 230 stomachs of the yellow-shafted flicker showed the presence of 5 per cent. mineral, 39 per cent. vegetable and 56 per cent. animal matter. Flickers are more terrestrial than other woodpeckers and a large part of their food consists of ants, which constitute nearly half of their food. Several stomachs contained little else and at least two contained more than 3,000 each of these insects. Beetles stand next to ants in importance, forming about 10 per cent. of the food.

Comparatively few passerine birds are treated as game, and among these few bobolinks (reed-birds), blackbirds, meadow-larks, and robins are the most important. The enormous number of bobolinks, Figure 4, which flock to the Atlantic coast each autumn to feed on the seeds of wild rice before taking their departure for the South and their presence in winter in South American countries, has given rise to the sport of reed-bird shooting, a sport scarcely known in other sections of the country. The bobolink is carefully

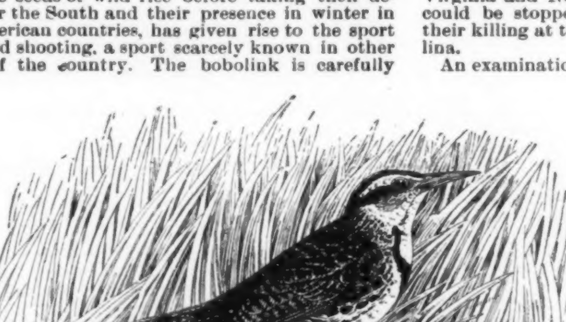


Fig. 4.—MEADOW-LARK (STURNELLA MAGNA).

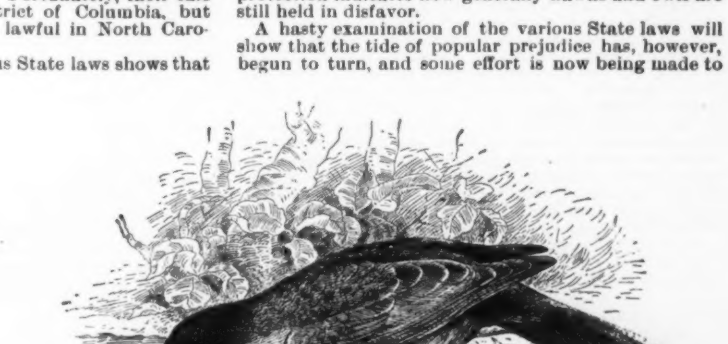


Fig. 6.—ROBIN (MERULA MIGRATORIA).

protected during its stay at its breeding haunts in the Northern States. It receives the name of reed-bird as soon as it appears in the Middle States in its autumn dress, where it is considered as legitimate game. In the Carolinas it is known as the rice-bird, and here it is considered legitimate game also, and may be killed at any season. By many persons it is considered a delicious morsel, although its diminutive body furnishes little more than a taste of meat. There would be no objection to utilizing the bird for food were it not for the abuse to which killing it for rice-birds for market has given rise. Not only are other birds killed for rice-birds, but in States in which reeds-birds do not occur marketmen try to make up the deficiency by furnishing various small birds under that name. Such conditions serve only to define the object of protective laws and for this reason, if for no other, reed-birds should be taken off the game list except in a few States where they are known to be abundant, and even there the sale should be carefully regulated to prevent the slaughter of robins, larks and other birds which are almost certain to be killed by market hunters.

Like the flicker, the meadow lark, Fig. 4, is considered game by many persons, mainly on account of the character of its meat, which in some respects resembles that of quail. Its importance to sportsmen is small in comparison to its value to the farmers. The bird is most emphatically an insect eater, evidently preferring insects to all other food, but deprived of its favorite food, it can exist on other diet. Prof. Beal made an examination of 238 stomachs and reported that the contents comprised about 20 per cent. of vegetable matter and 73 per cent of animal matter; no sprouting corn was found in any stomach, and no grain of any kind was found in stomachs taken in summer.

In the district of Columbia, red winged or marsh blackbirds, Fig. 5, are treated as game birds, and an open season for shooting them is set apart. An argument is made that, considering the damage they do to grain fields, particularly in the spring and autumn, blackbirds might be kept from becoming too numerous by treating them as game, but it may well be questioned whether this would reduce their number as effectually as if they were excluded entirely from protection in localities where they are injurious.

In some sections of the South, particularly New Orleans, all kinds of small birds, even thrushes, are considered legitimate game, and are offered for sale in the markets. Prof. Nehrburg says one great cause of the decrease of our small migratory birds must be looked for in the Southern States, where millions of all kinds of birds are killed to satisfy the palate of the gourmand. There is scarcely a hotel in New Orleans where small birds do not form an item on the bill of fare.

Robins, Fig. 6, are perhaps more generally killed than any of the other thrushes, and in some States their killing is legalized at certain seasons. A few years ago a large number of robins were shipped to the markets of Washington from various points in Virginia and North Carolina. Fortunately, their sale could be stopped in the District of Columbia, but their killing at this season was lawful in North Carolina.

An examination of the various State laws shows that the definitions of non-game birds offered protection are in most cases very loose. The matter of definition is a difficult one, in view of the number of birds now recognized in North America. Attempts have often been made to name the more important birds, as in the case of the Alabama law, which enumerates fifty species. Probably less than two-thirds of the North American birds are, strictly speaking, insectivorous, and a much smaller proportion are properly song birds. Inasmuch as game birds constitute but a small proportion of the avifauna of any State, it seems more reasonable to enumerate them than to extend protection to all others, as is now done in some States.

The general term "plume birds" is here used to include not only the herons, which are killed for their nuptial plumes, but a number of water birds, which are used for decorative purposes, such as pelicans, terns, gulls, and grebes. The snowy heron furnishes the well-known aigrettes; pelicans supply quills and breasts; gulls and terns are worn in great numbers on hats; while grebes' breasts, besides being used for trimming hats, are also made into muffs, collarettes, and capes. There is an enormous demand for plume birds by the millinery trade in years when they are in fashion, and the localities where the birds breed are scoured by hunters, who find a ready market for the skins at prices varying from 10 to 50 cents apiece. As these birds all nest in colonies, it is a simple matter to destroy large numbers on the breeding grounds; and so thoroughly is the work done that some of the species, particularly the egrets and terns, have been almost exterminated along the southern and eastern coasts of the United States.

The value of herons, terns, and grebes is not generally appreciated, and even the services of the gulls as scavengers are recognized in comparatively few places. As a result, birds of plume being neither game, song, nor "insectivorous," are not protected by the ordinary game laws unless by chance they happen to be mentioned in the list of protected species. Thus, by a curious perversity of circumstances, the species which are killed most mercilessly and in the greatest numbers are the very ones which are accorded the least protection.

Plume birds as well as insectivorous birds are protected in States which have comprehensive laws prohibiting the killing of all birds except game birds and certain designated species commonly considered injurious. But these States are few in number, and include only Arkansas, Illinois, Indiana, Massachusetts, New York, Rhode Island, and Vermont, and also the provinces of Manitoba and Ontario.

In view of the widespread prejudice against birds of prey, it is perhaps not surprising that comparatively little protection is given them. Only a few years ago several States endeavored to exterminate hawks and owls by means of bounties, and although most of the bounties have been withdrawn, protection is still withheld even in States which have the most comprehensive laws. The first of these species exempt from protection indicates how generally hawks and owls are still held in disfavor.

A hasty examination of the various State laws will show that the tide of popular prejudice has, however, begun to turn, and some effort is now being made to distinguish the useful from the injurious birds of prey. Nine States and the District of Columbia protect turkey buzzards, three States forbid the killing of eagles, one protects fish hawks, while one prohibits the killing of any hawks or owls. In addition, buzzards, owls, and certain hawks are included by implication in the list of species protected in Illinois, Minnesota, and New York.

It is somewhat surprising that the value of turkey buzzards is not more generally recognized. They are specifically protected in Maryland, the District of Columbia, Virginia, West Virginia, South Carolina, Texas, Oklahoma, Colorado, and Wyoming, but pro-

tection should be accorded them by all the States in the South and Southwest as well as the Territories of Arizona and New Mexico. According to Chapman, "their services as scavengers are invaluable." The work of these birds at Charleston, S. C., is well known, and the high estimation in which they are there held is shown by the fact that a fine of $10 apiece is imposed for killing them. The penalty in Texas ranges from $5 to $15, but about one-fourth of the counties in the State are exempt from the operation of the law. The term "turkey buzzard" includes not only the true turkey buzzard (Cathartes aura), but also the black vulture or carrion crow (Catharista urubu), which is found in the South Atlantic and Gulf States, where the two species often associate together. The laws of Texas and Virginia are apparently the only ones which distinguish the two species and mention, the one, the "carrion crow," and, the other, the "black buzzard," in addition to the turkey buzzard.

The protection of eagles is probably based on sentimental rather than economic grounds, and is inspired by a desire to insure against extermination the bird which has been adopted as the national emblem. Ohio includes eagles in its list of protected species and Connecticut protects them by a special law, while New Hampshire has prohibited the killing of any bald eagles before 1902 under a penalty of $40.

In the protection of hawks and owls nearly all the States are noticeably conservative, and few mention these birds in the list of protected species. Illinois extends protection to all birds, with the exception of "chicken hawks" and a few other species, New York to "wild birds," except hawks and a few others, and Minnesota to "harmless birds," except hawks, crows, blackbirds, and English sparrows. Rhode Island extends protection to the fish-hawks, while Utah is the only State which goes so far as to protect all hawks and owls.

In reality, so far from being injurious, the great majority of the birds of prey in the United States are decidedly beneficial. Of the 90 species which occur north of Mexico, about 17 consist of stragglers or of sub-species of little importance from an economic standpoint. Of the 73 important species and sub-species only 6 have been shown to be actually injurious, viz., the sharp-shinned hawk (Accipiter velox), Cooper's hawk (Accipiter cooperi), goshawk (Accipiter atricapillus), duck hawk (Falco peregrinus anatum), pigeon hawk (Falco columbarius), and great horned owl (Bubo virginianus). On the other hand, some of the species are decidedly useful as insect destroyers. Two of the large hawks commonly included under the term "chicken hawk"—Swainson's hawk (Buteo swainsoni) and the red-shouldered hawk (Buteo lineatus)—feed largely on insects, and the former bird destroys immense numbers of grasshoppers when such food is available. In an examination of 18 stomachs of Swainson's hawk, 8 were found to contain insects, and no poultry or birds were found in any; while of 220 stomachs of the red-shouldered hawk, 92 contained insects and only 15 poultry or birds. A still more striking example of grasshopper-eating proclivities is that of the sparrow hawk—one of our most useful birds. In referring to this species, Dr. Fisher says:

"The subject of the food of this hawk is one of great interest, and, considered in its economic bearings, is one that should be carefully studied. The sparrow hawk is almost exclusively insectivorous, except when insect food is difficult to obtain. In localities where grasshoppers and crickets are bundant these hawks congregate, often in moderate-sized flocks, and gorge themselves continuously. Rarely do they touch any other form of food until, either by the advancing season or other natural causes, the grasshopper crop is so lessened that their hunger cannot be appeased without undue exertion. Then other kinds of insects and other forms of life contribute to their fare. Beetles, spiders, mice, shrews, small snakes, lizards, or even birds may be required to bring up the balance."

The diet of these species would seem to entitle them to rank as insectivorous, but it is doubtful whether the State laws protecting insectivorous birds contemplated including any birds of prey under that term.

State laws generally prohibit the trapping, netting, or snaring of birds, for it is well known that a rapid decrease in numbers, amounting almost to extermination in the case of certain species, would speedily follow the wholesale capture which is possible under these methods. Such restrictions, aimed mainly at market hunters, are intended primarily to insure the preservation of game birds, but they are often needed to protect some of the smaller song or insectivorous species. In the vicinity of some of the larger cities a regular business is carried on in trapping certain native birds which are in demand for pets or cage birds. Mocking-birds, brown thrushes, bobolinks, cardinals, black-headed grosbeaks, indigo birds, nonpareils, house-finches, gold-finches, and others are captured in large numbers for sale.

Ordinarily no objection is made to keeping caged birds as pets, although there may be considerable difference of opinion on the question as regards native birds. But when large numbers are systematically trapped in any locality to supply the trade the practice is very properly condemned, and steps are usually taken to restrict the operations of the bird trappers.

OXYGEN AND GERMINATION.

M. P. Mazé has studied the part that oxygen plays in the germination of seeds immersed in water. This was done by placing them in sterilized water and adding varying quantities of oxygen gas. He concludes that seeds submerged in a liquid do not germinate for lack of aëration; further, when placed under water, though life appears to remain in a latent condition, the seeds are the seat of various diastatic changes. The hydrolyzing enzymes in particular, and zymase, preserve their activity as in the case of seeds germinating under normal conditions. On the other hand, the oxidizing enzymes cannot produce, in the body of a liquid, the oxidizing processes that the elaboration of reserve food material requires; for this reason the embryos of the young seedlings remain inert. Small seeds, e. g., those of the cruciferæ, are able to develop slowly by reason of an atmosphere within their coats, providing oxygen necessary for respiration. Starchy seeds rapidly lose the power of germinating when under water, oily seeds are more resistant, though there is no proof that any kind of seed can for long resist this treatment. The weakening of the vitality of the embryos in submerged seeds is due to the accumulation of toxic products, aldehyde in particular, in the liquid. All the facts observed show that the development of the plant seems to be the result of a certain series of diastatic reactions at the expense of the reserves of food materials stored in the seed, and that the equilibrium of these reactions once disturbed, the death of the plant sooner or later ensues. Temperature is an important factor; at a very low temperature the disengagement of gases might cease without life being destroyed, since gaseous exchange is only an expression of diastatic decompositions.—Ann. de l'Inst. Pasteur.

THE MAUSER AUTOMATIC GUN.

Herr Mauser, the celebrated manufacturer of portable weapons, took out a patent at the beginning of the year 1899, for an automatic repeating gun which, in its mechanism and operation, recalled the pistol of the same nature that he had previously brought out, and which replaced the revolver for the use of officers in the German army. The same inventor has quite recently made modifications according to the same principle in the German gun that has been definitely adopted.

In the Mauser automatic repeating gun, the energy necessary for its operation is furnished by the recoil produced by the firing of each cartridge. After a cartridge has been fired, the breech moves backward and carries along the barrel, which is connected with it and which cocks the hammer and tightens a recuperating spring.

The connection of the barrel and breech then ceases, and the former is arrested in its travel, while the latter continues to recoil, by virtue of the velocity acquired, and brings about the extraction and rejection of the

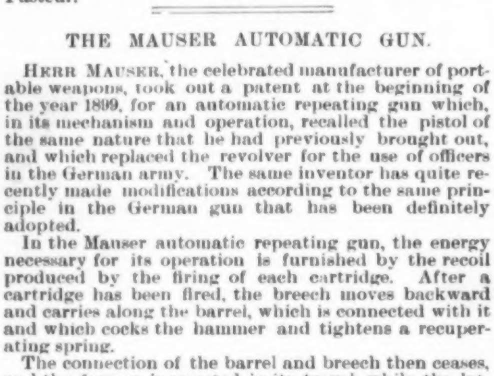


Fig. 1.—VERTICAL AND HORIZONTAL SECTIONS OF THE MAUSER GUN, WITH THE BREECH CLOSED.

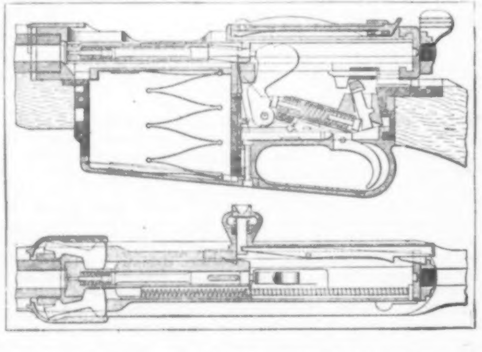


Fig. 2.—VERTICAL AND HORIZONTAL SECTIONS, WITH THE BREECH OPEN.

shell and the compression of a second recuperating spring. The first spring then expands and repels the breech, which shoves into the chamber the cartridge situated at the upper part of the magazine. After the breech is closed, the second recuperating spring expands in its turn and brings the barrel into a firing position.

All that is necessary, then, is to press the trigger in order to effect the firing. The operation of the weapon may continue in the same way until the magazine is exhausted. All that the marksman has to do is to charge the magazine, put the gun to his shoulder, take aim and press the trigger.

The accompanying engravings, made from drawings deposited by Herr Mauser in London at the time that he took out his patent, represent the back of the weapon in vertical and horizontal section in the closed and open positions of the breech.

We shall refrain from giving a description of the numerous parts of the mechanism, which is somewhat complicated, since this would take up too much space. We shall be content to call attention to the magazine and the spring that raises the cartridges, to the two recuperating springs, and to the two symmetrical pieces that are seen in the horizontal projection in front of the breech and that serve for connecting the barrel with the latter during the first part of the recoil.

At the back of the weapon there is a piece that can be arranged in three different positions—vertically to the right, vertically to the left, and horizontally to the left. To these positions correspond, respectively, firing by repetition, firing shot by shot, and the safety position of the weapon.—La Nature.

SEPARATION OF XIPHOPAGOUS TWINS.

The medical world of Brazil was startled by the announcement that on the 30th ult., in the operating room of the hospital of St. Sebastian in Rio de Janeiro, Dr. Chapot Prevost, one of Brazil's most distinguished physicians, had separated the eight-year-old twins, Rosalina and Maria, who had been the subject of much medical discussion during the past year.

[They were fully described in the Scientific American for February 24, 1900.]

These twins were born of poor parents in the State of Espirito Santo, Brazil, and were brought to Rio about a year ago. They were not united by a single band, as were the Siamese twins, but their abdominal cavities were connected by a large opening, practically forming one cavity, their bodies being intimately attached. And as it afterward proved, the thoracic cavities were also implicated.

The following brief and incomplete account of the operation and history of the case up to the present may be of interest. On June 23 of last year one of the leading Rio physicians made an exploratory opening, but finding the livers of the two girls so united as to form practically one liver he decided to go no further. Dr. Prevost then hearing of the case began a series of experiments to test the recuperative power of the liver, and the best means of controlling hemorrhage in this organ. Among the others he cut away a large part of a dog's liver, and in eight days it had almost reproduced itself. From these experiments he became convinced that this organ would bear a great deal of surgical interference, and he accepted the case.

Since last October the twins have been in this hospital under his care, and he has made a very careful study of the case from all points of view—anatomical, physiological, and psychological. He had several X-

THE XIPHOPAGES, ROSALINA AND MARIA.

ray photographs taken, and thus ascertained that the livers were united in nearly their whole extent.

While under his observation Rosalina had an attack of grippe, which lasted eight days, with a temperature on the third day of 40·2° C., with corresponding pulse and respiration, while Maria remained perfectly well. This confirmed him in his opinion that there were no psychological conditions to forbid their separation.

Having completed his studies and preparations he called a council of his colleagues who were to assist him, and explained to them his plans, and at 6 A. M. on the 30th ult. they assembled at the hospital to make the final preparations. Everything had been arranged with a view to the most perfect asepsis. The attendants, after taking a full disinfecting bath, dressed in new clothing thoroughly sterilized, and before entering the operating room washed their hands and arms in six disinfecting solutions.

Before the operation the girls were given clysters of 500 gm. of artificial serum, and their bodies were thoroughly washed, first with soap and water, then with sublimate solution, and finally with sulphuric ether, after which they were wrapped in sterilized cotton covered with gauze. They were then placed upon a table especially prepared, which could be easily unjointed to make two, Rosalina lying upon her left side and Maria upon her right side, the cicatrix of the former operation showing upon the top.

The giving of the chloroform began at 9:15 A.M., and after slight resistance on the part of both they were soon under its influence, and at 9:45 the first incision was made. This extended from the navel upward, having its middle at the ensiform cartilage, being closer to the false ribs of the right side of Maria. Turning back the flap toward Rosalina's side, the anterior superior

surface of the liver was seen. This occupied two-thirds of the connecting space and formed a bridge between the two cavities. Below this was discovered another connecting bridge formed by the union of the two mesenteries. After having cut through the cartilage in the median line another bridge was discovered. This was formed by the union of the two pericardial sacs, 2 cm. in extent, through which the fluid could easily be seen passing from one sac to the other owing to the uneven beating of the two hearts. The operator placed a pair of pinces de Péan upon either side of this connecting bridge preparatory to separating it. This was one of the most intensely exciting moments during the whole operation, for by the severing of the anastomosing branch of the two mammary arteries the field of operation was deluged with blood. The points were quickly seized and the hemorrhage controlled, but one of his more fearful assistants inquired, "Doctor, will you still separate them?" He simply replied "Separo" ("I will separate"), and cut through the imprisoned tissue, and sutured the cut edges of each sac with catgut. Now it was discovered that the pleura of Maria also extended across the line of union. However, before undertaking the task of correcting this, it was thought best to attend to the mesenteric bridge, as its position made it easy for the intestines of one to pass to the cavity of the other. This was prevented by ligating it with silk at two points and cutting between them and returning the contents of each cavity to their proper place. He then returned to the remaining difficulty in the thoracic cavity. This was overcome by cutting upon the internal face of the half of the cartilage yet united, detaching the parietal pleura, and uniting it with a fine catgut suture to the median fold, which adhered to the pericardial bridge.

Having thus completed the separation of the internal parts of the thorax, he then cut through the skin and cartilage on the other side, opposite to the first incision, leaving only the liver to be separated. This he accomplished in such a way as to give to each an uninjured gall bladder and duct. The final cut having been made at 10:50, and the table separated, he turned over Rosalina to two assistants, while he continued to care for Maria, who had suffered most from the operation. However, he had to suspend his work of closing up her wound to retie a ligature that had slipped from one of the hepatic vessels of Rosalina.

The final suturing was done on two planes, the deep peritoneal and the superficial, including the skin and muscular coat. At 11:45 the operation was completed. The condition of Rosalina was encouraging; that of Maria was much less hopeful. Little by little they were awakened, and upon opening her eyes, Maria, who awoke first, said, "Where is Rosalina." And Rosalina, upon awaking, asked the same in regard to her sister. When they saw each other, and realized that they were separated and still alive, Maria, looking toward Dr. Chapot, exclaimed, "Oh, doctor, how good you are!"—he had received his fee.

The children both vomited three times after the operation, and were given ice-water several times. Both during and after the operation they were given injections of artificial serum. They urinated without difficulty. After five o'clock they slept tranquilly with but slight interruption. At eight o'clock Rosalina wanted to say her prayers and put on a new dress the doctor's daughter had given her. The following is the schedule of temperature, pulse, and respiration for the first twelve hours:

	MARIA.			ROSALINA.		
	Temp.	Pulse.	Resp.	Temp.	Pulse.	Resp.
11:52 A.M.	36·0°	110	64	35·8°	Weak	45
3 P.M	36·7	126	46	36·6	110	38
5 P M	36 6	128	44	36·6	108	42
8 P.M	37·3	126	43	36·9	112	39
12 M	36·6	130	48	37·2	124	40

On the second day both slept well, though Maria, whose temperature ran up to 38° C. at 4 A.M., was somewhat disturbed. Her pulse at this time was 160, respiration 56; but at daylight these had all gone down somewhat. At 2:30 P.M. her temperature again ran up to 38·5°. She was then given an injection of artificial serum and inhalations of oxygen, after which she became better, and at 9 P.M. was quietly sleeping. Rosalina remained in good condition all day, and several times asked to sit up.

Third day: During the night they both slept well, and during the day the general condition of both improved, and they closed the day in good condition, the temperature of neither going above 38·2°. At midnight Maria was given inhalations of oxygen.

Fourth day: Until 2 P.M. both girls were doing finely, when Maria's temperature ran up to 39°, with pulse 172. She became quite weak and could not take nourishment. After taking inhalations of oxygen and a small dose of digitalin she became better. Her bowels were washed out, and she passed a large worm. At 9 P.M., temperature, 37·9°; respiration, 36; pulse, 150. At midnight both were sleeping, though Maria was somewhat restless.

Fifth day: The unfavorable symptoms of Maria of the day before did not return, and although very weak she was in every way better, taking with relish some broth at different times. The intestinal washings were continued with marked benefit. Oxygen was also administered throughout the day. The temperature did not get above 38·6°, and fell to 37·9°. Pulse, highest 150, lowest 137; respiration, highest 40, lowest 30.

Rosalina was in fine condition; she ate a little chicken and was anxious to sit up.

Sixth day: In the early part of the day Maria's condition was so flattering that the surgeon announced her to be out of danger. However, at 2:30 P.M. she began to vomit, and although this was checked, she became so prostrated that she could not rally under the supportive treatment given her, and at 1:30 A.M. of the following day she died.

At 3:30 P.M. the autopsy was held, at the request of Dr. Prevost, by the police physicans. He asked them to testify as to the following points, in addition to the regular facts of cause of death, etc.: (1) Had there been hemorrhage of the liver? (2) Had there been infection? (3) Was the death due to lack of skill, imprudence, or neglect?

The examination, made in the presence of a large number of physicians, revealed a state of inflammation of the pleura and pericardium, with more or less exudate from each, but no inflammation of the peritoneum, while the liver was completely healed and cicatrized, as were all the external wounds. All present agreed that everything possible had been done that could have been done, but of course there were some who could find something to criticise, either in the method of operating or in the after-treatment. The experts have not yet made formal reports.

Rosalina continues to improve without any drawback so far.—Medical Record.

THE DEVELOPMENT OF AGRICULTURAL LIBRARIES.

THE production of proper books for the advancement of agriculture has long engaged the attention of promotors of scientific farming, but it is only during the last century that these books have been supplied directly to the farmer. Furthermore, the supply has been thus far chiefly by books singly at home and through the agricultural papers. The newspaper and the single book cannot cover the vast field of agriculture and the farmer has constantly found himself wanting information on various subjects and his books and papers give him information on others in which he is not specially interested. His need is a library within reach that would furnish him in concise form the entire body of thoroughly good agricultural science. Farmers' Clubs, Farmers' Institutions, etc., have all helped to create a demand for books, and to some extent have helped to meet it. During the past ten years the traveling library movement has developed. As a result many small libraries are sent out to the rural communities and are constantly exchanging among them. Most of these libraries are made up, however, of light reading, and even such as are agricultural cannot be depended upon to meet cases of urgent demand.

libraries in the United States which have considerable collections of agricultural books.

Traveling libraries of agricultural books are most interesting. The movement originated in 1892, by Mr. Melvil Dewey, Librarian of the State Library at Albany, and it has been a special boon to rural communities. New York, through the home educational department of the University of the State of New York, offers among 50 lists of traveling libraries two that are made up entirely of agricultural books. One of these lists contains 34 volumes and the other 60. The agricultural lists are specially recommended to farming communities. They are loaned under proper regulations to existing libraries, to granges, farmers' clubs and similar organizations.

In Illinois, the traveling libraries are made an adjunct to farmers' institutes. There are two branches of the library work. One, in charge of the Superintendent of the Farmers' Institute, provides books on crops, stock, soil, fertilizers, etc., the other, under the management of women interested in farming progress, furnishes works on domestic science. A share of the annual appropriation for the farmers' institutes has been set aside for the traveling libraries. Our engraving represents the books as they are arranged in boxes for shipment.

Other States have somewhat similar arrangements. The Department of Agriculture promotes and stimulates reading of agricultural topics to farmers themselves to a greater extent than any other similar agency in the world. It has printed and circulated annually for the past five years an average of six million copies of these books. Nearly all of these have been sent directly to farmers. The experiment stations in all the States publish bulletins on their work, which are valuable to farmers and which are distributed to applicants.

The scientific farmer is not now ridiculed; he is observed and often imitated. The problem of furnishing all farmers with the means of becoming scientific in their methods is largely the problem already suggested, of bringing the right book to the right man at the right time. A large percentage of farmers have come to know that it is possible to get help from books.

AGRICULTURAL LIBRARY.

The establishment of permanent libraries of standard agricultural works near the farmer's home is a pressing need, and the Department of Agriculture is assisting such movement in every possible way. The "Year Book of the Department of Agriculture for 1899" contains a most interesting article upon the development of agricultural libraries by Charles H. Greathouse, M.A., of the Division of Publications, and we present an engraving taken from this report, showing a traveling agricultural library used in connection with farmers' institutes in Illinois.

In most countries science is unavailable to farmers, but the American farmer is ready for libraries; most farmers here are readers. They have proven themselves capable of understanding and employing improvements in farm practice. The founding of agricultural libraries in this country was first undertaken by the Agricultural Societies established in several of the States just after the close of the Revolutionary War. Agricultural Societies continued to be established with the development of the States and usually gathered libraries, but none of these were of much importance. Indeed, the really efficient libraries made their appearance only when the agricultural colleges and experimental stations had attained such a growth as to make such libraries a necessity.

The earlier agricultural libraries were of small size, but it must be remembered that in those days no libraries were very large. Agricultural libraries have now been established in connection with agricultural colleges and experiment stations in every State and Territory in the Union. In addition to their use by students in the colleges and stations many of these libraries are free to all who are likely to be helped. In the majority of these, the shelves are open to all readers, and farmers are especially welcome.

The "Year Book" describes in detail the Massachusetts College Library, at Amherst, which has 19,980 volumes, the Michigan Agricultural Library, 19,380 volumes, the Library of the New York Agricultural College, Cornell University, which numbers from fifteen to twenty thousand, and the Wisconsin State Library, which numbers five thousand volumes. In addition Society and State Board Libraries are described. In the Department of Agriculture at Washington there is a library of 68,000 volumes and of these books fully 75 per cent. are strictly agricultural. In addition to the agricultural libraries there are several hundred public

The difficulty is to put the information that will help where the farmer can get it on the day when the puzzling question presents itself. It does the farmer little good to receive a pamphlet containing certain information months after the subject has forced itself upon him.

It has been suggested that a good library of standard agricultural books might be established at every district school under the control of Trustees. It would be an important part of the work of the National Government to keep these collections supplied with results of recent discoveries as far as valuable for practical application to farm operation. Another suggestion for the location and care of such agricultural libraries is that they be put in the post offices under the supervision of the postmaster. The books would then be in the hands of a federal official and the farmers could send for their mail and books at the same time.

BACTERIOLOGICAL NOTES.

The Clinical Thermometer as a Germ Carrier.—It is pointed out by Conklin (Buffalo Medical Journal, February, 1900) that physicians are not always as careful as they might be over the sterilization of their clinical thermometers. The degree marks, scratches, and other imperfections in the glass of the instrument form excellent situations for the lodgment of micro organisms. A degree mark, for example, magnified 1,000 diameters, would measure 5 feet in length and nearly a foot in width! In this area 280,000 tubercle bacilli could be accommodated in a single laer. Conklin urges that not only should the thermometer be washed and wiped after use, but that the case should be large enough to contain some strong antiseptic solution in which the instrument would soak until used again.

Bacillus Pyocyaneus and Its Pigments.—Jordan contributes a lengthy paper on the pigments of Bacillus pyocyaneus to the Journal of Experimental Medicine (IV., 1900, Nos. 5 and 6, p. 627), and the following are some of his conclusions:—The fluorescent pigment formed by some varieties of B. pyocyaneus is produced under conditions identical with those governing the production of pigment by other fluorescent bacteria. The production of pyocyanin is not dependent upon the presence of either phosphate or sulphate in the culture medium and occurs both in proteid and in non-

proteid media. The fluorescent pigment may be oxidized slowly by the action of light and air as well as by reagents into a yellow pigment, and pyocyanin may be similarly oxidized into a black pigment. The power of producing pyocyanin under conditions of artificial cultivation is lost sooner than that of producing the fluorescent pigment.

Isolation of the Bacillus Typhosus and of the Bacillus Coli from Water.—Hankin describes a method for the isolation of the typhoid bacillus from a polluted water, which he states is frequently, but not always, successful. Five tubes are taken, each containing 10 C.c. of neutral bouillon. To four of the tubes one, two, three, and four drops respectively of Parietti's solution are added; to the fifth tube no addition is made—it serves as a control of the bouillon for the growth of micro-organisms. Each tube is infected with a few drops of the water to be tested, is capped and placed in the incubator at 37° C. for twenty-four hours. On the following day a variable number of these tubes will be found to be turbid. The tube containing the highest number of drops of Parietti that is yet turbid should be discarded. Usually the tube next below this in the series should be chosen, unless it has a thick scum, or has growth only in the depth. A tube should be preferred which has a uniform turbidity, without gas-bubbles, and is usually the one containing two or three drops of Parietti. The selected tube is then used to inoculate a second series of Parietti broth tubes, four or five; the first tube has the same addition of Parietti as the selected tube, the second tube one drop more, and so on. For example, if the tube with three drops is the selected one, the first tube of the second series has an addition of three drops of Parietti, the second tube four drops, etc. Two or three drops of the broth of the selected tube are used to inoculate each tube of the second series. They are capped and incubated as before. On the following day a tube is selected from the second series, as from the first series, and a third series of Parietti broth tubes is inoculated and incubated similarly to the second series. Again, from the third series a tube is similarly selected and either used to inoculate a fourth series, from which again a tube is selected for inoculation onto agar, or is used for inoculation onto agar. The tube chosen is now inoculated onto agar-tubes, the agar having a dry surface, so that colonies shall not run together. A loopful, on a glass bristle, is drawn from the bottom to the top of this sloping dry agar in a zig-zag manner, several tubes being so inoculated. These are incubated at 37° C. until the following day, when the colonies are examined. Each colony that is at all suspicious is then sub-cultured on to a fresh litmus-agar tube; this necessitates 5 to 10 tubes for a comparatively pure water, 10, 20, or more if obviously polluted. The tubes are incubated at 37° C. On the day after inoculation some of the tubes will have turned red, these may be discarded; after another twenty-four hours others may turn red, these may also be discarded. Of the tubes that remain blue, those in which the growth is obviously different from that of the typhoid bacillus may be disregarded. The remaining tubes are then subjected to a microscopical examination, and those resembling typhoid are sub-cultured into milk, potatoes, etc., and tested with typhoid serum as to their agglutination. The litmus agar employed is prepared by liquefying a liter of ordinary nutrient agar-agar in the autoclave, grinding up in a little water in a mortar 25 grammes of litmus and 30 grammes of milk sugar, straining through muslin, and adding to the liquefied agar, which is shaken, distributed into test-tubes, and sterilized in the autoclave. (Centr. f. Bak., xxvi., 18-19, p. 554.) Pakes also suggests a method for the isolation of typhoid and of coli, a method which again sometimes fails for typhoid. The medium employed is a glucose formate broth (0·4 per cent. of sodium formate). A measured quantity of the water is added to the broth tubes, which are incubated at 42° C. anaerobically by Buchner's method (alkaline pyrogallol). The high temperature (42° C.) and strictly anaerobic conditions inhibit the growth of most organisms, except typhoid and coli. At the end of eighteen to twenty-four hours the tubes are examined, and any which show signs of growth are further examined by plate cultivations. The other tubes are replaced in the incubator for another twenty-four hours, and, if at the end of this time there be still no growth, for a third twenty-four hours. Tubes which show a growth are examined as before, but if there is no growth after seventy-two hours the tubes are discarded. For the examination of water for the bacillus coli the same procedure is adopted, but the water is concentrated by filtration through a Berkefeld filter. (Public Health, XII., No. 6, March, 1900, p. 385.)

Significance of the Presence of the Bacillus coli in Water.—In the same paper Pakes draws the following conclusions from the presence of the bacillus coli communis in water. Drinking water from a deep well should contain no B. coli; water from other sources which contains the B. coli in 20 C.c., or less, should be condemned; that which contains the organism in any quantity between 20 C.c. and 50 C.c. should be regarded as suspicious; between 50 C.c. and 100 C.c. as slightly suspicious; and only in greater quantities than 100 C.c. as probably safe. If no B. coli be obtained from two liters, it may be regarded as absolutely safe. Pakes believes that the bacteriological examination of water affords more information as to the kind of contamination than the chemical. Oxidized organic matter, as evidenced by nitrates, for example, would probably be undetectable by the bacteriologist, but in another case where the water originally contained no B. coli in 50 C.c., and yielded 0·003 parts of albuminoid ammonia and absorbed 0·01 parts of oxygen per 100,000, after contamination there was one B. coli in every 5 C.c.—undoubted evidence of contamination—yet the figures for the chemical examination were only 0·004 albuminoid ammonia and 0·02 oxygen absorbed per 100,000.—Pharmaceutical Journal.

Property Tax in Madagascar. — Consul Gibbs, of Tamatave, informs the Department, under date of May 8, 1900, that a tax of 5 per cent. of the tenantable value of houses in Tamatave has been established by the governor of Madagascar. The full text of the decree, transmitted by the Consul, has been filed for reference in the Bureau of Foreign Commerce.

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TABLE OF CONTENTS.